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JUDGE COXE AGAIN.

In another column we print an abstract of a recent opinion written by Judge Coxe, in which that pompous jurist again indulges in some of his peculiar logic. The patent in suit was for the combination of a grounded gas-pipe, the ordinary lighting fixture provided with electric wires, and an insulating joint—in other words, the every-day electric fixture or chandelier. The argument upon the general considerations is one with which Judges Coxe, Green and Grosscup, in particular, have made us very familiar. First, we have the assumption of a mysterious new agent, then apparently insuperable difficulties encountered in its development; next, a picture of hosts of accomplished inventors working fruitlessly to overcome what threatens to block the advance of the new art, and, finally, the appearance of the inventor in suit, who almost miraculously succeeds where others—"even Edison himself"—have failed. A more fallacious line of argument can hardly be imagined, and that it should constantly be applied, apparently hap-hazard, by Federal judges is astonishing. There is much need for a school in which our patent judges may learn the elementary principles of their business as concerns passing judgment on electrical inventions, and we suggest that Judge Lacombe be made teacher, with the right of corporeal punishment—of which right this accomplished patent jurist would probably have abundant opportunities for exercise, in view of the apparent hopelessness of some of the prospective pupils.

STATE ENGINEERING EXPERIMENT STATIONS.

Prof. J. P. Jackson, in another column, explains the provisions of a bill now before Congress, having for its object the promotion by annual grants of money from the national treasury, of scientific investigation, engineering research and experimental testing at the various State colleges which are beneficiaries of the Land Grant Act of 1862. The majority of the colleges that would thus come under the provisions of the proposed law are at present but poorly provided with engineering laboratory facilities, and with the restricted incomes received from present resources the future holds out little promise to them from this direction. The avowed object in extending aid to this class of colleges was to promote the agricultural and mechanic arts; by the establishment of agricultural experiment stations this object has been greatly advanced with respect to the former, but thus far the mechanic arts have not received similar recognition, notwithstanding, as pointed out by Prof. Jackson, the greater possibilities for good on account of the vastly greater field for experimental research, and also, it may be added, the more experimental nature of that field. While the laboratories are to be attached to the various State colleges, their facilities will be open to the engineering public for experimental researches, which in itself should be a sufficient motive for their institution. No other department of applied science will be so favorably affected by the passage of the proposed bill as that of electrical engineering, and the inventors, experimentalists, engineers, and, in fact, all connected with this branch, should therefore extend to the measure their hearty support.

RÖNTGEN RAYS IN A VACUUM.

Prof. Oliver Lodge in a recent communication (see THE ELECTRICAL WORLD, Feb. 29, p. 227) makes the statement that Prof. J. J. Thomson has exposed a protected sensitive photographic plate in a vacuum to the action of the cathode rays and obtained no result therefore concluding that Röntgen rays, or at least no streaming particle, effect existed within the tube. The question has been raised whether Prof. Thomson should have found any effect even

were there such an action present. The popular impression is that the ordinary action of light upon a sensitive plate is to cause an oxidation of the chloride, bromide or iodide of silver present, the action being made manifest by the developer, which is the reducing agent. It has been generally accepted that such an oxidizing process takes place, but it has been shown that combined with this action is the more important one discovered independently by Portevin and Vogel, that in order to reduce the haloid salts of silver by light, the presence of halogen absorbents is necessary. Moist air or a vapor of mercury will act as an absorbent, and it is possible that the gelatine of a dry plate performs the same function. Schumann, of Leipsic, in his investigations on the photography of light waves of very small wave-lengths, used a 0.5 mm vacuum—a very low vacuum, it is true, compared with that of a Crookes tube—but as he was obliged to use special precautions in order that the residual gas should be perfectly dry, the conditions present were not favorable to either oxidation of the chloride or to the absorption of the free chlorine by moisture. We are inclined to believe that Prof. Thomson, who is looked upon as a careful investigator, fully satisfied himself that an ordinary sensitive plate, when placed in a vacuum, may be effected by the action of light. In case no such action takes place, however, he has proved nothing by the experiment. Mr. H. Carey Lea has shown that plates subjected to mechanical pressure undergo chemical changes which are capable of indefinite increase by the application of a reducing agent. Even accepting the streaming particle theory as the explanation of either the cathode or Röntgen ray, it is still questionable whether Prof. Thomson should have found any chemical effect produced. The matter is one of considerable importance, and can be quite easily verified by any one possessing a good air pump.

MOTORS VS. SHAFTING IN FACTORIES.

We commenced in our last issue and conclude in another column, an article by Mr. Baxter on the application of directly connected motors to various types of machines. The question of the practical advantages to be gained by the use of motors in preference to holding to the old method of shafting is one which deserves the attention of all factory managers. Although the present tendency of society is toward increased convenience rather than increased economy, the relative importance of the two must be combined in factory management where the cost of production must be reduced to a minimum and where newer and more expedient methods must constantly be studied. It is from this point of view that every manager should look upon the adoption of any new method and be able to decide to just what extent proposed changes are advisable. In the case of factories already in operation, the question of discarding long lines of shafting and directly applying motors to the individual units is a serious problem to confront and to answer, to which no general statements or conclusions are applicable. There are, however, in most factories, many points in common, and to these cases more or less general statements can be made. For instance, there can be no question as to the advisability of directly applying motors to large machine tools where current is available, or where several such units distributed about a factory warrant the installation of a generator; or, in case the buildings are separated, to transmit power electrically from a central point. As soon as this is decided the question immediately arises as to what shall be the minimum size of motor used, and to what extent shall individual tools be individually supplied. A study of the particular conditions presented in each factory can alone decide this problem, for it can be stated with certainty that the use of a number of extremely small motors will, in general, not be advisable owing to their inefficiency, increased cost per unit of output and greater liability to damage. Cases can be imagined where the use of such might, to some extent, be warranted, yet the question would still arise whether a general grouping driven from one or more counter-shafts would not be more expedient. Prof. Crocker, at the Niagara Falls meeting of the Institute, brought out the point that the average power required to drive machine tools is much below that generally estimated, and that motors, as a rule, run from 50 per cent. to 75 per cent. below their full load. This combined with the fact that the load ceases when the tool stops, offers considerable economy when compared with continuously running shafting. However, as the cost of power is a relatively small item in the operating expenses of a factory, the problem seems to reduce itself to the question of first cost and convenience. As Mr. Baxter states, the use of motors in factories has but just begun, while the future promises an extensive increase in their direct application to machine tools.

Alternating-Current Experimental Curves.

The effect of the exponental term which appears in the complete solution of the ordinary differential equation of condition for an alternate-current circuit, has been generally neglected by most writers. In the last number of the *Physical Review*, Mr. F. E. Millis gives the results of a series of experiments in which he photographically records the effect produced at the moment of making and breaking an alternating current in a circuit having self-induction, and shows that this induced current not only has a physical existence, but that it may become an important factor in alternate current working on circuits of large self-induction when the load is subject to great and sudden variation.

If the current phase is zero at the moment of closing the circuit, the induced current is zero, but is a maximum when the phase angle is 90 degrees. It was therefore from this latter instant that the phenomenon was investigated.

The combination of an alternating curve with another curve of any form whatever is in effect the same as making the alternating curve symmetrical about the second curve as an axis. Hence the curve obtained upon closing an alternating-current circuit having self-induction and resistance is symmetrical about the logarithmic component of the curve. But this logarithmic component is the same as the curve of dying out, inverted and properly displaced. Hence, by obtaining this curve of dying out on one plate and on another plate the combination curve produced by closing the circuit, and then invert the first and superpose them, so that the same ordinate shall pass through the point of breaking the one and the closing of the other, the combination curve should be symmetrical about the logarithmic curve as its axis. By this method Mr. Millis is able to show the similarity of the experimental curves to the curves indicated by theory.

Educational Tests.

An excellent test to apply when it is desired to obtain an infallible indication of the scientific calibre of one professing scientific attainments, is to open a conversation on light and sound and observe whether the subject of the inquisition is aware of the distinction between the media of propagation and of the different nature of the vibrations. Similarly, the scientific standing of those who, in writing on Röntgen phenomena, use the term "X-rays" instead of "Röntgen rays," is definitely, though adversely, fixed.

Metric System.

In a recent speech in Congress favoring the adoption of the metric system, a number of absurd existing laws were pointed out, and among them a law in Vermont which caps the climax for absurdity. This law, which according to a comparatively recent legislative digest is still in force, specifies that for measuring certain commodities "one bushel and three-quarters of a peck shall be deemed a bushel."

Three-Phase Currents in Germany.

According to the statistics of central stations in Germany for the past year, it appears that the output of central stations in which the three-phase current is used, is greater than that of all the stations in which the single-phase alternating current is used.

Fundamental Electrical Fixture Patent Sustained.

Judge Coxe on March 10 handed down a decision on final hearing in the case of George Maitland *vs.* Archer & Pancoast, which sustains the Stieringer patent for improvements in electrical fixtures. The point at issue, as the validity of a patent claim for an electric light fixture, wholly or largely of metal, provided with insulating conducting wires conveying current to lamps thereon, in combination with an insulating joint at the upper end of the fixture. Judge Coxe in his opinion says that he is convinced that Stieringer was the first to make the use of gas chandeliers a practical success in the art of electric lighting; that while prior structures were not only dangerous, but awkward and ungainly, that of Stieringer is absolutely safe, and at the same time preserves the symmetry and graceful contour of the fixture. "When," he says, "the conditions surrounding the genesis of electric lighting are remembered, it can hardly be denied that the man who yoked the old with the new, and fully developed the art of electric lighting, was something more than a mechanic. It is plain that he who utilized for electric lighting the expensive and intricate gas light systems then existing, and the fixture which embodied a multitude of graceful designs, took a long step forward. He made electric lighting cheap, convenient, simple and safe. . . . A number of accomplished inventors were at work on this very problem. They accomplished nothing. Stieringer succeeded. It is not an unreasonable presumption that one who succeeds in doing what so accomplished an inventor as Edison failed to do is on a distinctly higher plane than a mechanic. Not only did Edison fail himself, but he was among the first to acknowledge the merits of the invention, practically as well as theoretically, for his firm took out a license under Stieringer's patent." The opinion proceeds to say that Stieringer's joint, located at the ceiling, seems to be regarded as one of the absolutely essential features where an internally wired metal fixture is used. The court defines the combination in suit as having the following elements:

First—A metallic fixture for electric lights containing insulated conducting wires. Second—An insulated joint located at the upper or inner end of the fixture and having metallic coupling portions and an intermediate section of insulating material. Third—The grounded piping of a house by which the chandelier is thus supported. The decision is that this claim is infringed, and the complainant is entitled to the usual decree.

The National Conference on Standard Electrical Rules.

A conference upon the rules for the installation and operation of electric apparatus took place in the hall of the American Society of Mechanical Engineers, at 12 West Thirty-first Street, on Wednesday and Thursday of last week. The meeting consisted of representatives of the leading electrical, architectural and insurance interests, who were called together by invitation of a committee of the National Electric Light Association. After effecting an organization the rules of the Underwriters' National Electric Association, as published with the imprint of the National Board of Underwriters, were read section by section, and formed the basis of extended discussions in comparison with other similar rules, both foreign and American.

The question of rules was referred to a special committee, who will submit a report at some subsequent session of this body. Upon the report of a committee, of which Prof. Crocker was chairman, the name of the "National Conference for Standard Electrical Rules," was adopted to designate the body. Those present at the conference were:

Prof. Francis B. Crocker, of Columbia College, of the American Institute of Electrical Engineers.

Mr. Frank R. Ford, of the American Street Railway Association.

Mr. Wm. H. Merrill, of Chicago, Ill., electrician of the National Board of Fire Underwriters.

A. S. Brown, of the Western Union Telegraph Company.

Francis W. Jones, of the Postal Telegraph Company.

Alfred Stone, of Providence, R. I., secretary of the American Institute of Architects.

Capt. Wm. Brophy, of Boston, Mass., of the International Association of Fire Engineers.

Mr. C. J. H. Woodbury, of the American Bell Telephone Company.

Lieut. S. Dana Greene, of the General Electric Company.

Charles F. Scott, of the Westinghouse Electric & Manufacturing Company.

E. A. Fitzgerald, of the Underwriters' National Electric Association.

Edward V. French, electrical inspector of the Associated Factory Mutuals of Boston.

W. T. Hammer, H. J. Smith, E. A. Leslie, and J. I. Ayer, of the National Electric Light Association.

A. E. Kennelly, complimentary delegate.

During the discussion on the rules, Mr. A. E. Kennelly recommended that the committee should adopt a rule that the secondary coil of converters be grounded at its centre, as a protection to life. Mr. Francis W. Jones regarded this recommendation favorably and remarked that if all converters had been properly made, some unfortunate things, now fresh in the minds of the delegates, would have been averted. He believed that the conference should establish some regulation as to the construction of these appliances. Mr. J. I. Ayer disclaimed any connection with or particular sympathy for manufacturers, but he believed that Mr. Kennelly's plan would result in the destruction of a great many transformers. It would put too great a strain on the insulation. The transformers would be liable to burn out. Mr. Kennelly admitted that the grounding of the secondary coil might cause the loss of some transformers, particularly during thunder storms, but such a loss was hardly worth considering in view of the resultant protection to human life. As it was, there might be no loss of transformers at all, as there was protection in the primary coil. Life should be guarded first of all.

State Engineering Experiment Stations.

BY J. P. JACKSON.

A bill is now before Congress providing for the establishment of engineering experiment stations, one in each State and Territory of the Union. The general object of the bill is to "promote scientific investigation, engineering research and experimental testing for the best interests of the naval service and the industrial development of the several States." These stations are to be situated at the colleges which are the beneficiaries of the Land Grant Act of 1862. The stations are to issue bulletins at least quarterly, giving the results of any investigations that may have been carried on during that period.

The bill further provides that opportunities for post-graduate work be granted technical school graduates and that under proper conditions acting or retired naval officers may be assigned to duty at the stations.

The support to be given the stations is ten thousand dollars ($10,000) the first year, which is to be increased at the rate of one thousand dollars ($1000) per year, to a maximum of twenty-five thousand dollars ($25,000). The money thus appropriated is to be used *exclusively* for the necessary expenses in engineering investigations, and is *not* to be used in any way toward the support of the institution with which the station is connected.

In order that direct advantage may be gained by the general government, the stations are to be placed under the direct supervision of the Secretary of the Navy, and the Secretary is empowered to carry out through the stations any lines of investigation that will be of service in naval construction.

The bill further states the purpose of the stations to be: "To aid the States and Territories in the experimental determination of the composition of their minerals, fuels, construction materials, and other resources, as well as the scientific and economic questions involved in the utilization of raw materials and the development of water-power, steam and *electricity* in the production of manufactured products, and such other experiments or researches bearing directly on the industrial development and material prosperity of the several States and Territories, as may be deemed desirable, having due regard for their varying resources, conditions and needs; to cooperate with and give scientific aid to the several States and Territories in protecting life and property from engineering accidents, casualties and negligence, and in the supervision of engineering inspection and granting of engineers' licenses."

The bill also provides that the experiment stations shall be the depository for such books, drawings, apparatus, etc., as the Secretary of the Navy may be able to furnish in aid of the experimental work.

The aim of this bill, the principal features of which have just been given, is certainly in the right direction. National support for scientific investigation has been provided for a long time in some of the European states, and to some extent in America, and without doubt the results have warranted the expenditure. In this country the advances made in engineering, however, have been largely through investigation supported by manufacturers or performed in the college laboratories.

The former practice will always be more or less observed, but investigation carried out by manufacturing companies, although excellent, does not cover the range or go as far as is to be desired, also the results obtained are private property and may not become available for public use until they become of some value.

The college laboratory is created for a different purpose, namely, to furnish instruction on scientific lines. Such instruction to be effective in producing well trained and practical men must be largely confined to knowledge previously gained, and can merely point toward the fields that may be opened in the future. Post-graduate work in the college laboratories frequently accomplishes much for science, but even here the range is limited. Probably the best use of the laboratory for the purposes of investigation is made by the instructors themselves, and that they have done much is evident on glancing over the transactions of our scientific and engineering associations or the volumes of the journals published on these lines. But a college instructor is employed for other purposes, and can usually give only odd moments to scientific research, thus being unable to give this work the attention that it rightfully demands. In addition to this he is liable to be handicapped by not being able to obtain essential special pieces of apparatus.

The individuals qualified by nature and education who endeavor on their own resources to carry out scientific investigation are, in most cases, so handicapped by lack of facilities as to make accomplishment impossible, though there are some notable examples to the contrary.

The measure under consideration will establish facilities where engineering and scientific experts may be employed to give their whole time to research in the lines before indicated. Moreover, men who are at present trying to carry out special lines of investigation will have an opportunity in these experimental stations to make use of the apparatus and literature essential to their work. The laboratories of these stations may be made very complete as they may use as a basis the large and effective equipment already to be found in our land grant colleges. A very commendable point is that the results of the experimental work must be given to the public for general use. The stations are provided to be established under the same rules as apply to the agriculture experiment stations which were created a few years ago and which have proven already such an advantage to the farming industries. We would predict a far greater success for the engineering stations as the field of usefulness opened before them is limitless.

These remarks apply especially to electrical engineering as the practical and scientific investigation of electricity has extended more rapidly during the past few years than any other field of research, and is destined to continue extending at probably a more rapid rate for many years to come.

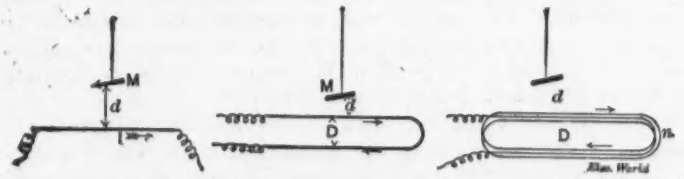
After a careful study of the plan presented by this bill it appears to be worthy the careful consideration and hearty support of any engineer.

A Simple Method for the Measurement of Electric Current.

BY ICHIRO GOTO.

It may sometimes occur that the strength of an electric current is desired to be known when no measuring instrument is at hand. The following method which I have devised is very useful on such occasions, as nothing is required except a scale and a magnetic needle.

A small magnetic needle is suspended from a silk fibre and held vertically over a horizontal wire, say three feet long, a few centimetres under the centre of the needle, the wire having a direction perpendicular to the magnetic meridian (Fig. 1.) The current which



FIGS. 1, 2 AND 3.

it is desired to measure is then passed through the horizontal wire and in such a direction that its magnetic force on the needle is opposite to that of the earth's field.

By adjusting the height of the needle, a position can readily be found where the magnetic forces due to the earth and the current neutralize each other, at which point the needle acts as if it had lost its magnetism. Measuring this height of the needle above the wire gives the data required for substitution in the following formula.

Let d equal the height of the needle in cm, I, the current strength in C. G. S. units, and H, the horizontal intensity of the earth's magnetic field, also expressed in C. G. S. units. Then, since the strength of the field due to the current in the wire is expressed by $\frac{2I}{d}$, evidently in the neutral position,

$$H = \frac{2I}{d}, \text{ or } I = \frac{dH}{2};$$

or, since I is in C. G. S. units, the current, C, in amperes

$$= \frac{10\ d\ H}{2} = 5\ d\ H.$$

In Tokio H is very nearly .3, so for that place the formula becomes $C = 1.5\ d$.

By this method I measured several currents which in another room were simultaneously measured with a Kelvin ampere-balance as accurately as possible. The two results being compared, I found, much to my surprise, that there was a difference of only from 2 to 5 per cent. between them.

For large currents the wire should be so arranged as to diminish the magnetic force on the needle due to the current, and Fig. 2 shows an arrangement for such a case. Similarly, for small currents the arrangement should be such as to increase the magnetic effect, as sketched in Fig. 3.

In the two foregoing cases the formulas are somewhat different, but yet remain simple of calculation. In the case of heavy currents (Fig. 2),

$$C = 5\ d\ H \left(1 + \frac{d}{D}\right) \text{ amperes.}$$

In the case of small currents (Fig. 3),

$$C = \frac{5}{n}\ d\ H \left(1 + \frac{d}{D}\right) \text{ amperes,}$$

where D is the distance apart of the parallel wires in cm, and n is the number of loops.

By the method here pointed out it will be seen that any current (strong or weak) can be easily measured, and with considerable accuracy, with the aid merely of a magnetic needle and scale.

Röntgen Rays.

Mr. Max Osterberg, a Fellow of Columbia College, delivered a lecture before the New York Electrical Society on Thursday, March 19, on the subject of Röntgen rays. Mr. Osterberg brought out the point that Prof. Röntgen in his original paper describes the principle of the so-called crytoscope, which is now claimed by, or for, several Americans as their invention. He also established the fact that Crookes and Spottiswood some years ago announced the fact that the vacuum in a tube is actually improved by the effect of the oscillatory discharge which takes place through it. Mr. Osterberg believes that this improvement in the vacuum is due to the presence of electrodes within the tube, as he found that if external electrodes are used no such increase of vacuum takes place. The lecture also treated of pseudo-Röntgen rays. Images were thrown on a screen showing that glass, which casts a heavy shadow to Röntgen rays, casts none whatever in a so-called Röntgen print taken by means of sunlight; furthermore, that when the plate-holder is closed with an aluminum slide no effect whatever is produced by sunlight, thus establishing the fact that hard rubber slides allow filtration of light; and, finally, that if the plate-holder is placed so that the rays of sunlight strikes it at an acute angle, no shadow pictures are produced, this showing that reflection takes place and thus proving the absence of Röntgen rays.

Dr. d'Arsonval in a paper read before the March meeting of the Societe Internationale des Electriciens stated that incandescent lamp bulbs of greenish glass are particularly suitable for Röntgen ray lamps. At the same meeting M. Charles Henry showed that phosphorescent sulphate of zinc produced fluorescent effects similar to platino-cyanide of barium. M. Becquerel obtained the same results with uranium salts. M. d'Arsonval said that he employed a Geissler tube placed in a fluorescent glass tube. This tube, excited by means of a Ruhmkorff coil, was placed four inches from a photographic plate enveloped in several thicknesses of black paper, and his conclusion from the results was that the fluorescent rays alone act to produce the Röntgen effect.

Mr. Edison has recently employed tungstate of calcium with his fluorescent screen or "fluoroscope" experiments and, according to a newspaper report, finds it to be six times more sensitive than platino-barium cyanide.

Central-Station Working—XIII.

HIGH-VOLTAGE PLANTS, STATION DESIGN AND OPERATION.

BY H. E. RAYMOND.

THE past four years have witnessed the installation of quite a number of power-transmission plants. In these the current used is polyphase-alternating, and the voltage employed varies from 2200 to 3000 volts. The length of the lines varies from three to ten miles. In the installation of such systems, under these conditions, very few "line effects" were anticipated, it being thought that static capacity and possibly resonance would be experienced only on lines of considerably greater length and with the use of a much higher voltage.

Developments have shown these effects to be particularly noticeable in systems in which synchronous motors constitute the main portion of the load. When static transformers comprise the greater portion of the load the effect seems to be greatly lessened.

In one synchronous motor system, which extends over a distance of but four miles and employs a voltage of 2500 volts, the static or capacity phenomena were so marked as to be the cause of considerable trouble. This effect was first noticeable in connection with fuse blocks of the "magazine" principle. These blocks consisted of two fuses in multiple, one being opened about one quarter of an inch by means of a thumbscrew. When from any cause the first fuse blew, the current would invariably jump the gap and run on the other fuse. Though quite convenient as an automatic shifting device, it is hardly necessary to state that the life of the fuse block was prematurely short.

At each end of the system there was, on each wire, a lightning arrester with a total gap to ground of three eighths of an inch. At times when the lines were being tested for grounds, a small arc would form from the line through the arrester to the ground, the current returning through the ground detector. If any grounds were in existence on the line the arc in the arrester would, of course, be much more intense. At the same time, the current would jump from the ring terminals to the shaft, or from the brush-holder studs through or around the rubber washers to the frame of the machines. This discharge to the ground and frame of the machine nearly always took place at the motor end of the system.

During any sultry day in Summer there was a likelihood of a discharge taking place through the arresters, and as these were entirely incapable of rupturing the succeeding arc, the arrester was generally repaired by putting up a new one and burying the old. All these events were accompanied by displays distinctly interesting as pyrotechnical exhibitions, but as looked at from a superintendent's standpoint were not nearly so enchanting.

The remedy for most of these troublesome phenomena was the use of the almost anciently, but we find not widely, known "tank" arresters. These have been so arranged that they can be left in connection or cut out at any time, and cleaned, repaired, etc. They are arranged one to each wire entering the station, and if one or two be thrown in and the switch on the other nearly closed, a spark will jump the open space of one quarter to three eighths of an inch and continue to do so steadily, showing the continual accumulative charge. Beside using these tanks, marble or rubber guards have been inserted between all exposed points of different potential in order to minimize the danger from current arcing from one to the other.

In many stations one thing, the absence of which is the cause of more trouble in alternations of high potential than everything else combined, is remarkably conspicuous in its neglect. This is cleanliness. It is very surprising how little attention is paid to this decidedly particular point. A few examples of its neglect and the result will not be out of place here. During a visit to a lighting station supplying a town of about 20,000 inhabitants, the attendant was asked: "How often do you inspect and clean your lightning arresters?" The answer was: "Never." A short time later they lost two armatures, not by a grounding lightning stroke, but through a short circuit through their arresters and the dirt of years which they contained.

In another station, in which there is every facility for keeping everything up the highest round in the ladder of condition, the machines are cleaned "running," and very often when shutting down every man but the watchman is out of the building before the belts stop. One day the writer noticed a very discouraging accumulation of dirt and vaseline on the rings and brush holders of a large 2500-volt alternator. Three weeks latter an addition to this collection was noted, and a few days after this an armature coil was burned out, caused by a short-circuit on the brush holders. After rewinding the armature the machine was started and the voltage built up to about 2000 voltage, short-circuiting again. This was repeated several times with the same result. The machine was then stopped, cleaned and a few exposed points taped. The machine was again started, the voltage brought up to 2800 volts, and it has been running satisfactorily ever since.

In another station somewhat similar to the preceding example the machines are cleaned every day, not with a broom on the outside of the yoke, but thoroughly and carefully inside the armature spider and laminations, inside of the shield protecting armature coils, between the rings and around all leads, brushes, etc. Commutators and brushes are smoothed and cleaned every week and overloads of 45 per cent. are carried every day; in the case of a small motor car an overload of 200 per cent. (making three times full load) has been carried without a spark. The expense of all this care is less than 50 cents a week, and, aside from the element of safety, from burn-outs and short-circuits that such cleanliness introduces, the constant attention makes it impossible for a screw, nut or bolt to come loose or the slightest irregularity to occur unnoticed.

One of the worst things for repair houses and one of the best for stockholders is extreme cleanliness in all stations, and outside of them, too, for that matter.

Speaking of returns to stockholders reminds me of various "economies" practiced by different managers which are interesting studies in connection with their results. For example, in one station that contains generators for light and power and motors for running generators and factory shafting, an oil was used for two years with first-class results. This oil was manufactured by a well-known concern and cost about 30 cents a gallon. This was used in ring oiling bearings from four to seven months without changing, and then more in order to be on the safe side than because it needed it, was removed, filtered, mixed with an equal quantity of new oil and used again for six months, receiving again the same treatment, and so on indefinitely. The superintendent was desirous of cutting down all minor expenses and purchased a quantity of oil from another concern that was "just as good" and cost 5 cents (!) a gallon less! This was, of course, a much more economical grade to use! The attendant filled a large ring bearing containing two and one half gallons with this oil. In less than 30 minutes they had to shut down for an hour to scrape the bearing. The oil was put on the coal pile. A few minutes more and the bearing would have had to be re-babbitted. About 300 hands were idle all this time. A few days later a street railway system was shut down for more than an hour, a gang of machinists worked half a night and a new box put up in one place. All this was risked to save 5 cents a gallon. Indeed, not only was the possibility risked, but the probability.

Such specimens of economy (?) are daily practiced in hundreds of small stations, and in the plants of large manufacturing establishments.

Adapting arrangements to circumstances and planning to fit conditions are among other points that seem to receive very little of th e attention due to their importance.

For example, there are several plants furnishing power to outsiders, and using the surplus themselves for haulage, hoisting, etc. One such has a driving source for their generator, shafting, etc., of 400-hp capacity. This motor drives a factory load of 120 horse-power and a street railway generating set. The street railway has an average load of from 200 to 250 horse-power, but requires a maximum daily output of 400 to 500 horse-power. This maximum lasts but a few minutes at a time, and occurs every half hour. The "surplus" is used to drive a locomotive of large capacity that makes trips of a mile each way up grades and around curves when loaded, and down grade empty. If this locomotive ran on schedule time so as to make its maximum demand when the street railway gave the lightest load, it could triple the number of cars drawn, and that with less strain on the machinery. Instead of this it runs at all times, generally going down light when the street railway is light, and trying to come back loaded when three quarters of the cars on the other road are going up severe grades. Then they complain because a circuit-breaker comes out or a fuse blows.

This point of adapting circumstances to conditions is of especial importance in the installation of new systems and particularly in the case of street railways of small size. Instead of doing this there seems to be a remarkably prevalent custom of copying some other station or system running under entirely different conditions, as in a power-house now being planned (?) and erected. This railway has a Winter (eight months) average of four to seven cars, and a Summer average of seven to twenty in extreme cases. It is to be equipped with two 400-hp units, one to run all the time, the other to be used as reserve. The efficiency of this plant when four cars are running, or even when six or seven are, can be imagined, but not easily. It looks as though an efficiency test would show results rather discouraging to stockholders.

In another locality a road of six or seven miles in length was built, equipped and running in less than two months, and as an example of the contractor's push is a shining star. From an engineering point of view the brilliancy is not quite so apparent. The power-house is situated at a point that is very convenient for visitors and the attendants, but that point happens to be at the end of the road that has less than one third of the heavy pulls, the severe grades and sharp curves being from four to six miles from the station. The track is simply bonded, and two feeders connect with the trolley. This was so arranged because a road in Massachusetts was the same. The soil is nearly pure sand and rock, and the drop at the far end with only one car is 200 volts. Incandescent lamps were connected from the trolley to the ground, five being strung in series. They were to be used for illumination, but when a car was moving at that end of the line their photometric measurements would about equal that of the bright end of a cigar.

This was so built, as we have said, because other roads had about the same arrangements, and in spite of the fact that several good sites and shipping facilities for coal could be obtained at the end with the heavy pull. The middle of the road was not suited owing to the lack of water facilities.

In the power-house of this same road the engine first installed was put in a vacant lot at the end of a year. It was second-hand and the steam pressure was too much of a strain on the cylinder heads and on the nerves of the force employed. Two second-hand generators either burned out or grounded in several places on the commutator shell, the last event probably being due to the senile debility of the generator. This station has besides feeders to the positive bus-bar, two feeders connected to the rail outside, and also grounding underneath the station in salt-water mud. It was suggested to the management that lightning arresters on the positive feeders would be a certain sort of protection. The suggestion was more than acted upon, as they were installed also on the grounded feeders, connecting to them about 10 feet from the ground, and to the same wire again about six feet nearer the ground. It is only fair to state that in spite of all this the road is considered to be a good investment.

All of the foregoing examples are not extraordinary individual cases, but represent a too well-known type, and certainly do not require any discussion. They are all object lessons in themselves. Every owner or prospective owner of stations or systems, of either small or large size and output, owes it to himself to see that all conditions, both natural and technical, are complied with, and common sense and care exercised in subsequent management.

Owing to the fact that multiphase-current power transmission has come into general use so very recently, a short detailed account of some of the difficulties overcome in one of the first plants installed may be of interest and value to some. The experiences here given are in connection with the Baltic & Taftville three-phase transmission systems. In this plant the voltage is 2500 volts. The apparatus for line and switchboard as first set up was of the type ordinarily used in lighting stations of about 2000 to 6000 lamp capacity and employing 2000-volt primary circuits. The switches were of ample capacity as far as copper was concerned, and were mounted on slate bases. The current indicators were furnished with ordinary brass binding screws. The lightning arresters were of the old style, G. E. 2000-volt alternating-current arresters. The first troubles were from the utter destruction of these arresters, as mentioned previously. This was stopped by using the "tank" arrester in connection with a new type shunting arrester with a gap to ground of considerable increase, and a decided improvement in the arc-rupturing device. The tanks in this plant are only at one end of the line, and while not necessary at both ends, we would recommend them in all cases where storms are frequent and of long duration, as they save the arresters from the strain and damage due to continual discharges. These tanks are 16 feet long, 10 inches wide and 12 inches deep. They have a copper plate at each end, connected one to the line, the other to the ground, and are partly filled with clean water. The energy dissipated in the full set is practically nil, not being sufficient to bring a 16-cp 100-volt lamp up to candle-power.

The system consists of two generators driving two synchronous motors of corresponding capacity. The voltage is not transformed, the lines leading direct from brush to brush. It was found that with any "old-style" switch the circuit could not be broken at all. For example, a switch that had been used to open a transformer load of 30 amperes and 2000 volts would not begin to break a current of 10 amperes and 2100 volts, but would be all melted down with the ensuing arc. After several experiments a switch was made for us by the General Electric Company which answers all requirements. It is simply a modification of a quick-break 600-volt switch, so arranged as to form a triple-pole switch with a large break, with ample guards between the blades. It is mounted on white marble, this being the only material sufficiently free from iron.

In all minor details changes were made increasing insulation and in simplifying. The indicators were all furnished with rubber-capped binding screws. The usual brass cross-bar on double and triple pole switches was changed to hard rubber. Large rubber washers were put on the brush holder studs. The original complicated and many pointed brush holders were exchanged for a very simple one consisting simply of a flat spring, a copper conductor, and a clamp at each end for brushes or stud. On the switchboard, between every fuse and protecting every point exposed to a possible arc, are placed marble slabs set on edge.

One more incident hardly connected with power transmission and yet probably more likely to occur in the station of such a system than in any other on account of the high speed of the units together with their size, is the unfortunate accident—a burned or melted bearing. If the bearing should be heated so as merely to start or flake the babbitt, it is of course a very simple matter to repair it. But the bearings of the large power generators and motors now made are so massive that, under some conditions, all the babbitt may run from the box before the outside has become heated. If this happen, the machine being of large size and the shaft deeply scored, it is decidedly not so simple a matter to remedy. Some time ago we had an experience of this nature on a machine with all the pillow-blocks cast rigidly to the frame. The shaft was cut in grooves nearly ⅛ of an inch deep for the entire length of the bearing. The heat and subsequent wetting had hardened it, and it was scored so deeply that filing was out of the question. There are two ways out of the dilemma, one of which was to send the armature, weighing 6000 pounds, to be refitted with a new shaft, or to turn down the damaged portion. No lathe was at hand half large enough. After some puzzling the shaft was turned down .23 of an inch in its place in the machine. The method adopted was as follows, and a short description may be of use to some:

The head of a planer with carriage, tool post, etc., was set on its back on a heavy wooden crib built around the bearing and bolted to the rails. This head was placed under two clamps in such a way that it could be adjusted to parallel the shaft by means of small wedges. The tool was necessarily long in order to reach the shaft from outside the bearing, and while very small at the cutting end was one and one half inches square the entire length of the shank. The cutting portion had to be three inches below the tool post, and had only two inches in which to travel at right angles to the shaft. At this end, therefore, the tool was abruptly drawn down to one half an inch square, and bent sharply down and then doubled back on itself such a distance as to reach the proper cutting position. Here it was ground off to a diamond point. The armature was revolved from a temporary counter-shaft and the shaft turned down and polished in place.

The shell was originally of alternate strips or sections of iron and babbitt and, of course, had to be made smaller in order to fit the new size of the shaft. This was done by boring out part of the iron section and filling with solid anti-friction metal. The shaft being centred to the other two bearings and the new one clamped in place, the repaired shell was seated in a babbitt bed in line with the others. This bearing, although one quarter of an inch smaller than designed, has never caused any trouble since, and runs easily when the machine is carrying a 50 per cent. overload.

This incident is simply illustrative of the point brought out above—trying to fit the conditions—and shows that if this idea is followed out many opportunities will occur when the accident expense account can be reduced, or not allowed to grow at all.

A Surface-Contact Street Railway System.

An interesting system of electric street railway traction is now in course of experimental test on Thirty-fourth Street, New York City, which has attracted considerable attention from those knowing the undeniable advantages offered by a successful closed-conduit or surface-contact system. This latest Johnson-Lundell system, to which we refer, is the result of much experience by the inventors in experimental closed-contact work, and embodies improvements suggested by previous tests made on a larger scale.

Fig. 1 is a general view of the section of track, showing two rows of contact buttons eight feet apart lying between the rails. The

FIG. 1.—SURFACE-CONTACT ROAD UNDER CONSTRUCTION.

contacts in one row are staggered relatively to those of the other. For every four contacts there is an iron switch-box situated just outside the rails, as shown diagrammatically in Fig. 2. The contact buttons or pedestals, as they might be more properly called, are castings somewhat resembling a section of T-rail, except that they have two webs at right angles to each other; one of these pedestals is shown in Fig. 3. The pedestals are mounted on an insulating block and secured to the ties by lag screws, so that they project a short distance above the pavement. The conductor wire is connected to the pedestal at a hole drilled in its base and runs in iron-armored conduit to the switch-box. Each pedestal is surrounded by a wooden box in the form of a truncated square pyramid, open at the top, and the box is filled with asphaltum, which furnishes insulation sufficient for the momentary charging to which the pedestal is subjected. In fact, any leakage is confined to the top surface of the pedestal.

Two main feeders pass through all the switch-boxes successively, and four wires lead from each switch-box to the four nearest contact

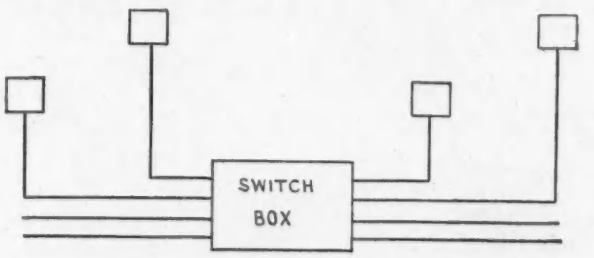


FIG. 2.—SWITCH-BOX CONNECTIONS.

pedestals. The main feed-wires, like the pedestal-wires, are encased in iron-armored conduit, and can be readily drawn in or out of the tubes. The wires enter the outer casing of the switch-box and pass into an inner compartment and thence upwardly to the contact magnets. After the wires are arranged the inner central compartment of the box, shown in Fig. 5, is filled with insulating compound. It will be noted that the edges of this inner compartment are about half way from the top of the box proper.

On the edges of the inner compartment, and also on the top of four pillars cast in the corners of the boxes, are cast pockets which receive the corners of slate slabs on which are mounted two switch magnets. These magnets are thus supported in the upper part of the contact box, which could therefore be half full of water without interfering with them. The whole magnetic apparatus is covered with a galvanized iron box, which, being air-tight, forms a sort of "diving bell," and by atmospheric pressure prevents water from coming in contact with the magnets, even if the box be surrounded by water. Should the bell be withdrawn when the box is in this inundated condition, the amount of water that would accumulate in the bottom of the box would be so small that it could not reach the magnets in their elevated position.

The magnets for making contact with the live circuit, and thereby supplying current for the pedestals, are not yet standardized. The form used in the experimental section on Thirty-fourth Street is

FIG. 3.—A CONTACT PEDESTAL.

shown in Fig. 4. A magnet of the ordinary bipolar type is set on a slate base with its poles up. On these poles are two knife edges, and on the knife edges swings a frame cast of brass. On the rear of the frame is cast a rectangular pocket, which is filled with melted lead, thus giving it weight, and tending normally to keep the rear end of the frame down. On the front of the frame are mounted two spring brass brushes which, when the frame is tilted forward by the magnet, strike two carbon brushes, and thus make electrical connection between them. A piece of iron secured to the frame over the poles of the magnet forms the armature for actuating the cut-out. The carbon brushes are rectangular, with beveled edges, and fit into dovetailed clamps secured to the base.

The car carries two contact "skates," approximately 10½ feet in

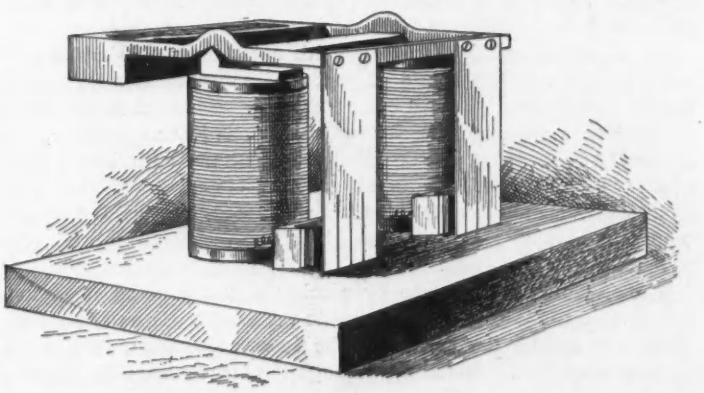


FIG. 4.—SWITCHING MAGNET.

length. Each skate rubs along the tops of the contact pedestals, the arrangement of the contacts being, of course, such that the skate passes from contact to contact without breaking connection. Stiff bristle brushes keep the contacts clear for the skates. In a recent test the car was repeatedly stopped and started in a mixture of slush and mud so deep that the skates were entirely submerged. The

performance of the equipment was entirely satisfactory under these extreme conditions. A notable feature of the system lies in the fact that the changes in the car equipment are mere additions. The addition of two contact skates and suitable connections is all that is necessary to prepare any equipment for service over a section of this system. The cost of the system is said to be but $12,500 per mile.

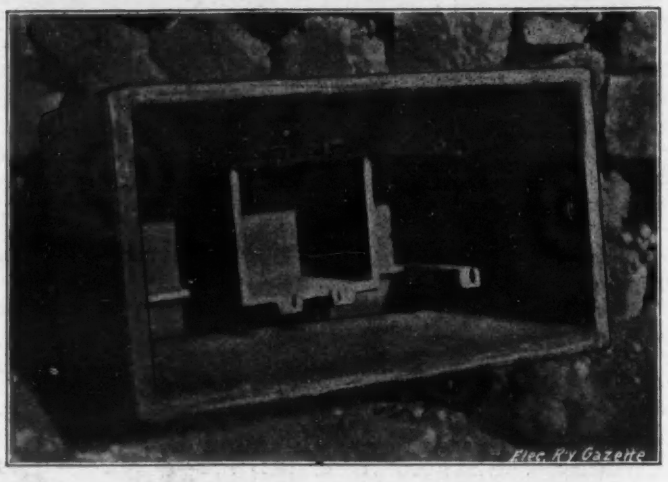


Fig. 5.—Switch-Box Without Magnet.

Röntgen Rays "Anodic" Not "Cathodic."

BY ELIHU THOMSON

Since the first publications concerning Röntgen's discovery of the rays emanating from a Crookes tube, it seems to have been assumed by most investigators that said rays have some relation to the radiant matter of Crookes, which is a phenomenon of the cathodic terminal.

Others, again, have considered that the rays discovered by Röntgen were produced at the glass surface or during transmission through the glass, and as a consequence of the impingement of the cathode rays upon the glass, causing its fluorescence. Prof. J. J. Thomson is reported to have exposed photographic plates to the cathode rays or radiant matter within the tube without having produced any effect which could be brought out by development.

Very recently Prof. H. A. Rowland has pointed out the fact that the Röntgen rays are emitted from the anode, and not from the cathode, and this view coming from so high an authority is in itself an indication of its probable truth. The writer, personally, had been led to suspect that the rays were anodic, not cathodic; for it was found that the rays when traced to their source within the tube by methods which have been published by him, came from that terminal which during the passage of the spark discharges could not have been the cathode. Using a Wimshurst machine it was easy to determine the polarities. Furthermore, the best effects on the photographic plates were produced opposite that portion of the glass which became strongly fluorescent. This fluorescence, however, could not have been produced from the cathode, as the rays normal to the cathode surface would not have impinged there.

By constructing a dark tube with a screen of barium platinocyanide the writer was able to submit to examination the various forms of Crookes tubes in his possession. Some of these, though fluorescing strongly by the cathode rays, gave at no position, with respect to the screen tube, any indications of the emission of Röntgen rays, while some gave feeble indications near the anode, and in exceptional instances a strong effect was noted, not from those parts where the cathode rays made the glass fluorescent, but from other parts opposite the anode.

The crucial test was made by placing a small patch of opaque metal upon the side of a tube opposite the anode. It was found that when the anode, the patch and the fluorescent screen were in line, no fluorescence was obtained, although the screen was fully exposed, as it were, to the cathode.

It may be mentioned here that the fluorescent screen tube forms a most valuable means for rapidly exploring the field of the Crookes tube, and so determining whether it can be used as a source of Röntgen rays or not. It also enables one to determine the best direction in which the rays are emitted, and is much quicker than the sensitive plate for such observations.

In one of the tubes examined the effects appeared to indicate that the Röntgen or anode rays are deflected or turned aside sharply when they arrive near the cathode terminal, which in this case was a bent sheet of aluminum. This effect is worthy of further investigation.

The writer also personally exhausted a Crookes tube by a Sprengel pump, watching with the fluorescent screen tube for the first indications of Röntgen rays. It was found that when that degree of exhaustion was reached which gave an excellent exhibition of radiant matter from the cathode, and even clear cut shadows of objects by such rays, as evidenced by the brilliant fluorescence of the glass where the rays impinged, there still was no indication of Röntgen rays, even when the fluorescent screen in its dark tube was not more than a quarter of an inch from the strongly fluorescing glass wall. As, however, the exhaustion improved, the indications of Röntgen rays began to be manifest, and at last they became quite pronounced. These rays seemed to originate at the anode, and although they may possibly be deflected in the vicinity of the cathode, they otherwise proceed in straight lines from the anode and through the glass, causing fluorescence of the latter in much the same way to all appearances as the cathode rays, except that while the cathode ray fluorescence is fairly stable or stationary, the anode ray fluorescence flits about or changes its direction with every discharge, scarcely, if ever, repeating the same pattern of fluorescent patches on the walls of the tube or bulb.

The following summary of effects is apparently in accord with the facts:

First: Cathode rays are produced at lower exhaustions than give rise to anode rays that reach the glass.

Second: Anode rays are best produced at the very highest exhaustions short of insulation.

Third: Anode rays pass out through the glass of the Crookes tube: cathode rays (radiant matter) apparently do not.

Fourth: Both anode and cathode rays cause fluorescence of the glass and possibly of many other substances.

It is not known whether anode rays cause fluorescence of any substances that are not so affected by cathode rays, and *vice versa*.

Fifth: Anode rays are erratic in distribution from the anode surface. Cathode rays are of nearly uniform distribution, and leave the cathode surfaces at right angles.

Sixth: Anode rays are not capable of being deflected by a magnet; at least not after they have passed the glass. Cathode rays appear to be so deflected within the tube and after they have traversed an aluminum window. (Lenard.)

Seventh: Diminishing the size of the anode concentrates and focalizes the rays emanating therefrom. Shaping the cathode into a concave cup gives rise to a focus of cathode rays by virtue of their direction being normal to the cathode surface.

The question suggests itself: Can anode rays reach and pass through a thin aluminum sheet, which is at the same moment the cathode for the discharge? And, on the other hand: Can cathode rays traverse the anode if of thin aluminum sheet? It is probable that opacity of the opposite terminal would be noted in these cases, and possibly, deflection of the rays in each case near the terminal of opposite polarity to that emitting the rays.

The significance of Röntgen's discovery is greatly enhanced, and the scientific interest therein multiplied when it is recognized that there may be an entirely unsuspected radiation, not from the cathode but from the anode; that both electrodes may emit radiations characteristic of the electric states of the terminals, and that such radiations are widely different from each other and from other known radiations. If the anode rays are longitudinal waves in the ether, what are the cathode rays? If the cathode rays are longitudinal, what are those of the anode? Is it possible that neither of them are longitudinal vibrations of the ether, and that one must now look for an explanation of the two radiations which shall be alike, and yet not alike?

In these radiations there may be again a manifestation of differences between positive and negative electrical states, which differences seems to be in some way impressed on the radiations set up in the neighborhood of the poles. There undoubtedly is a great field for research opened by the discovery of Röntgen, and it is fortunate for science that the Crookes tube he experimented with possessed a high enough vacuum to cause it to give anodic as well as cathodic rays.

Ten Cents a Pound for Locomotives.

By a curious coincidence the new Westinghouse-Baldwin locomotive weighs 160,000 pounds and costs $16,000, which is just 10 cents a pound.

Theories of the Röntgen Rays.

BY W. M. STINE.

It is probable that the true nature of these rays will not be definitely determined until the present excitement has dissipated itself, and competent experimenters have seriously and laboriously investigated the problem. It may soon be found that the Röntgen rays are as seemingly incapable of explanation with our present state of physical advancement as the various Geissler and Crookes phenomena. Although present physical knowledge may not be competent to effect the solution, it is still sufficient to point out many fallacies in the hypotheses already suggested. Physicists, as a rule, are probably the most conservative class of scientists, and persistently cling to old theories for explanation of new phenomena. This is strikingly shown in repeated refusal to acknowledge the ether may be granular or discontinuous, and that none other than transverse vibrations may be possible in it. As an instance, the fate of Clauchy's theory of refrangibility may be noted. The hypotheses of the nature of the Röntgen rays have accordingly been advanced along old lines, and may be summed up as three in number; (a) infra-red rays; (b) ultra-violet rays; (c) transverse waves of extremely high frequency. The first hypothesis may be dismissed in a few words, since it was promptly proven that media, impervious to infra-red rays, were transparent to the Röntgen rays. Abundant experimental data are at hand to disprove the second hypothesis. The writer had the pleasure of being the first experimenter in this country to announce that crossed tourmaline plates did not stop out the Röntgen rays in the least, and that the length of exposure to the Röntgen rays was not affected by the light speed of dry plates. Prof. J. J. Thomson has just announced the same result with tourmaline plates, and the observations on the speed of dry plates has subsequently been fully confirmed by experimenters, both in England and in this country. Prof. Röntgen himself found these rays could neither be refracted nor polarized. Ultra-violet rays are capable of discharging a static charge of negative electricity, but the Röntgen rays seem to discharge either positive or negative charges with equal facility. The influence of the two classes of rays in producing fluorescence is also widely different. The behavior of the tourmaline plates is practically conclusive evidence against the ultra-violet hypothesis, and it is rendered more conclusive by the action of dry plates; besides the permeability of matter to the ultra-violet rays is highly selective, and to the Röntgen rays this is but slightly manifested.

The third hypothesis is no more tenable. Under the conditions of production of the Röntgen rays, it does not seem possible that transverse waves of extremely high frequency are induced. Granting that they are the true Röntgen rays, they would be polarized and stopped-out by the tourmaline plates to an observable extent. They would also affect dry plates in proportion to their sensitiveness to ordinary actinic rays. They would be able to be focussed to a marked degree, for, "increased wave-frequency, with unaltered speed of light, certainly implies shorter wave-length, and most probable, greater refrangibility."* Such waves could as readily be reflected as ordinary light rays. The writer has made repeated attempts to reflect the Röntgen rays, but without any success whatever. In a few cases, where slight indications of a reflection were obtained, an analysis and repetition of the test showed the indications to have been misleading, and due to insufficient protection of the plate from direct rays from the tube, and to the leaking of actinic light through the covering of the plate. Slight indications of reflection have been reported by experimenters, but their results are probably erroneous, for the reasons noted. But, if the rays were transverse, reflection would be so marked as to leave no doubt. Transverse vibrations have only *selective* penetration, *i. e.*, through transparent substances, and in general, the shorter the wave-length, the less is its penetrating power, for the more certain is it to be reflected and absorbed. In addition, were the Röntgen rays such waves of extremely high frequency, they should be emitted from both the arc lamp and Bunsen burner, both of which sources have been conclusively proven to have no sciagraphic effect.

We now come to Prof. Röntgen's hypothesis, that of longitudinal vibrations, and it may be briefly stated that experimental evidence strongly supports this view in part. It is, however, incomplete for at least two reasons. It has long been known that longitudinal vibrations of even great wave length can be reflected. Were the Röntgen rays longitudinal vibrations pure and simple, they should be found associated with all light, and even heat sources, and should be produced wherever light waves are reflected. A more probable explanation is that the sciagraph is produced by a species of electrolysis by a complex ether wave, combining at once the longitudinal character with a tube of electric induction. This view has also been advanced by Prof. Oliver Lodge. The indifference of the rays to the light speed of dry plates strongly confirms the electrolytic explanation. To further test this opinion, the writer powerfully excited a tube of fluorescent uranium glass, but found it would not produce the Röntgen ray. It is also noticeable that the most active tubes are almost devoid of fluorescence. As bearing on this explanation, it is to be noted that nothing but an electrically excited Crookes tube has been proven to reproduce a true sciagraph. Probably the nature of the Röntgen ray will only be definitely determined when we obtain a complete knowledge of the mechanical action of an electrical charge when borne by an atom or molecule.

In this connection it is to be regretted that the masterly work of Prof. Röntgen was not completed by giving a name to the phenomena he announced to the scientific world. A name of some sort is a necessity, and for the sake of uniformity no time should be lost in adopting some descriptive term. The editors of our technical press should consider the question without delay and adopt a name. So far, at least, four expressions have been employed—skotograph, radiograph, shadowgraph and sciagraph. Three considerations should guide in such selection; the name should be euphonious, it should be etymologically consistent, and, if possible, an already authorized term. The term skotograph is incorrect, for *skotos* means darkness or gloom, and as such is not descriptive of the phenomena in question.

The term radiograph should not be employed, for it already has a well-defined meaning, since it is given to "an instrument for measuring and recording solar radiation." Neither does the Röntgen ray pass out radially from a point, as the term radiation invariably applies to spherical emission. Shadowgraph carries its own condemnation, for it is a compound of an English term with a Greek root. It is no better nor worse than such a barbarous term as soundgraph instead of phonograph.

The names *sciagraph*, *sciagraphy* and *sciagrapher* are already authorized terms, employed in denoting pictures in light and shadow. They are etymologically correct, since they are derived from the Greek words meaning "shadow" (*skia*) and "writing." We would not then be adding new and unnecessary terms to our dictionaries, nor violating the accepted definitions of terms already in use.

* *Light*, P. G. Tait, p. 203.

The Direct Connection of Electric Motors with Machines of Various Types.—II.

BY WILLIAM BAXTER, JR.

The efficiency of transmission by shafting, as has been shown in the previous article, is less with light running machinery than with heavy; but lightness of machinery is not the only factor that determines the efficiency. The continuous or intermittent use of power has as much to do with the subject, if not more, than anything else. If a machine absorbs a large amount of power when in operation, it must be driven by heavy shafting. If it is in constant use the loss of energy in shafting and belts will be small; but if not in constant use, this loss may become very great, and will depend wholly upon the ratio between the time when work is being done, and when the machine is standing idle. From a consideration of this fact we can see that under certain conditions of intermittent use the loss in operating heavy machinery by shafting may be very much greater than with the lightest machinery, especially if the latter is kept in constant motion.

The field in which the direct connection of motors with machines would make the poorest showing would be that when the power required is not very small and the work continuous. On the other hand, the best results would be obtained with machines requiring a large amount of power while in operation, but only in use for short periods of time, with long intervals of rest. In the former class may be mentioned cotton and woollen mill machinery, and all kinds of automatic machinery used in manufacturing processes. Among the latter are printing presses, paper cutters, embossing machines and, in fact, most of the machinery used in this line of industry, also wood and metal working machinery of all kinds.

We cannot say that the work performed by machines of the classes just named is always of an intermittent character, but it is generally so. Printing presses, in some cases, are used continuously, but as a rule their work is intermittent, and they are frequently stopped for

periods some times of several hours' duration, owing to the fact that the number of copies required of any one form is seldom sufficient to keep them in operation for any great length of time. Even when the work on hand is enough to keep all the presses in an establishment in constant use, the number of hours when power is used is not a very large proportion of the whole. It requires a considerable length of time to remove the old forms and put new ones in place. To clean the rollers, try the press, and examine the proof copies and to make sure that everything is in proper adjustment before starting to run off the edition. In most printing establishments it is not uncommon to see half the presses idle at a time. It is evident, therefore, that in this line of work the energy lost by shafting is a large percentage of the whole, so that as far as efficiency is concerned this is a very favorable field for the direct connection of motors.

What has been said in relation to the work of printing presses not being always intermittent also applies to wood and metal working machines. Thus, for example, we may consider the case of a lathe used for turning shafting. In such a case the use of power would be almost continuous, because it would require a considerable length of time to finish one piece, and the work of removing this and putting in place another piece would only require a few minutes, owing to the fact that the work is of a routine character, and all the appliances for setting and holding the work in place are made with a view to saving labor in manipulation. But if the same lathe is used for general work the results will be very different. More time will be required to set and secure the work in place, because special means to accomplish this end will have to be used in almost every case. After the work is properly set and secured, and the latter is set in motion, there will be a considerable time lost, from the fact that frequent stoppages will be made to examine the progress made, and to take measurements, and perhaps to make comparisons with other parts of the apparatus to which the piece may belong. In some cases the time consumed in cutting away the metal of a casting or forging is very small compared to that required to set the work and make the necessary examinations and measurements as the cutting progresses.

These few illustrations are sufficient to show that in operating machines by the ordinary method of shafting and belting the loss of energy is greatest where the work is of such character that the machines do not run continuously, and that the very lowest efficiency is attained in cases where, in addition to the work being intermittent, the machinery is light, and, therefore, the transmission of energy per unit of length of shaft very small. On the other hand, the highest efficiency is reached in that class of work where the machinery is in continuous use, or nearly so, and where length of shafting is greatest.

From these facts we must conclude that in the direct connection of motors with machines we could obtain the best results in the efficient use of energy by selecting machines that require a small amount of power for their operation, and are used for a class of work in which the intervals of rest are numerous and of considerable duration.

It is somewhat unfortunate that these are the conditions that will enable the direct connection of motors to give the best results in point of efficiency, because, as will be presently shown, the class of machines in which these conditions obtain are generally those in which the combination would compel the motor to undergo the severest test. But no one need be discouraged on this account. Electric motors, when properly constructed, are wonderfully enduring machines, and have been accustomed to hard knocks since the days of their infancy. The ideal condition of running for a motor, that is, for ease of task, would be that whenever it could be started in the morning and then be kept in motion with a constant load all day long. But these conditions do not obtain in any of the direct connections so far made with the exception of fan blowers and pumps and are hardly to be expected in any of the work of the future. The work that is now being done by direct-connected motors imposes the severest conditions that are possible, therefore no fear need be entertained that any combination that may be made hereafter will fail because of the inability of the motor to withstand the strain; although it may be possible that the wear and tear caused thereby may be enough to offset all the gain in other directions.

It is difficult to conceive of any kind of work that would impose a greater strain on motors and the operating apparatus used therewith, than that to which they are subjected in railway and elevator service. Such motors when, starting under a heavy load, are subjected to a rush of current that almost amounts to a short circuit; that is, if they are geared for a high velocity, and therefore are compelled to set the mass in motion without any undue loss of time. Under these conditions the strain on the insulation is very great, and it would soon break down unless of the most substantial construction. But this is one of the minor troubles which is easily guarded against. The effect on the commutator is far more difficult to contend with. Unless the best judgment and skill are used in designing the machine, there will be a violent spitting of sparks at the brushes at the instant the armature begins to turn. This will reduce to an almost imperceptible spark as soon as the velocity becomes high enough to enable the C. E. M. F. to cut the current down to a reasonable point. But absolutely sparkless running in such a motor is not possible, because the flashing at the instant of starting roughens the surface of the commutator over a considerable arc, and as the motor seldom starts with the armature in the same position, each start roughens a new spot, and finally the whole surface becomes rough. If the starts were at long intervals apart, the action of the brushes during the long intervening run would smoothe up these spots, but as the starts are very frequent no such results can be effected. Therefore, the surface of the commutator remains constantly rough, and consequently the brushes spark continuously. Yet a motor that would act this way, when subject to the severe test imposed upon it in railway or elevator work, would in all probability run sparkless if in continuous motion and subject to the ordinary variations in load that stationary motors have to contend with. It will, therefore, be seen that for this class of work a motor must be proportioned with much greater accuracy, to avoid sparking, than is required in machines subject to the ordinary conditions encountered in stationary work.

While the class of work that enables a motor to run with the least possible strain is that when the motion is continuous and the road uniform, that which produces the greatest strain is, when the load is intermittent, when the weight of the moving parts is great compared with the power required to keep the machine in motion, and when it is necessary to stop and start frequently; yet this is the field in which the greatest amount of work has been and is being done, in the way of the direct attachment of motors to machines.

If the question of the efficient use of power were to decide whether the combination of a motor with any particular machine would be desirable, the prospects in this line of work would not be very bright, particularly if the cost of maintenance were to be brought in to off-set the saving in power. The cost of power in most manufacturing establishments is but a small percentage of the total expenses, therefore the saving of a portion of this expense would not effect the economy of operation to any very great extent; and if this slight saving were to be reduced by the increase in cost of repairs, as well as first cost—if these should be against the motor—the chances are that, in most cases, the advantages of the new method would not be enough to justify its adoption. But other considerations as well as economy have a bearing on the case. Among these may be mentioned that in many establishments the belts and shafting are in the way, and interfere with the proper handling of the work. These conditions exist in large iron and other metal manufactories, where heavy work is handled, and where overhead traveling cranes are almost indispensable. These cannot be used if line shafts and belts are in the way. This difficulty is overcome in many places by running a line of shafting against the wall on each side of the shop; but if the building is of any considerable width, it will be found that, in most cases, there is more unoccupied floor space along the centre than is really required, and that some of it could be utilized if power could be conveyed to tools located thereon without interfering with the crane. In several shops of this kind experiments are being tried with lathes, planers' boring mills, and other tools operated by motors. There can be but little doubt that these experiments will be successful, and in the course of time a large number of direct-connected iron-working tools will be used in establishments of this kind.

A considerable work is being done at the present time in the direct connection of motors with printing presses of various kinds. Perhaps one of the largest plants of this class, if indeed not the largest in the world, is that of the American Book Company, located in the new building erected on the site of the old University Building, on the east side of Washington Square, in this city. This plant, when completed, will consist of nearly a hundred machines, each provided with a direct-connected motor, with the exception of some of the smallest machines, which are driven in groups of four or six to one motor.

What the advantages of direct-connected machines in printing

establishments may be, the writer would not undertake to state, not being familiar with the requirements in that line of work, but that the advantages must be quite apparent is evident from the fact that those who know what the requirements are have been sufficiently impressed with the advantages to be derived from direct attachment to induce them to try the experiment on such a large scale.

When we consider the question of operating machinery in general from all the various standpoints that suggest themselves, we cannot very well come to any other conclusion than that there is not much probability that the old-fashioned shafting and belting will be replaced to any great extent by the system of operating each machine by an independent motor.

If the cost of energy required in manufacturing establishments were a large proportion of the entire expense; and if the gain in efficiency were not offset to a certain extent by the increase in first cost, and the greater expenditure for repairs, the advantages to be derived from the direct application of motors to the machines would be, perhaps, sufficient to warrant the adoption of the system in a majority of cases. But as these advantages are, at the most, only enough to effect the total cost of operation by a small percentage, it follows that the old methods will not be abandoned, except in cases where there may be other advantages far greater than the mere question of economy.

There is another field, however, for the electric motor in manufacturing establishments, in which the advantages to be derived from its use are more apparent than those that may be claimed for the system of direct connection with each machine. This field is that of operating each line of shafting or system of shafting by an independent motor. It frequently happens that the construction of a building is such that it is not possible to drive each line of shafting from the main line, and that the only way in which the power can be transmitted is from one shaft to the other, and so on through to the last. With such an arrangement one line of shafting could not be used without driving all the other lines, and this, in most cases, would be a decided objection. But if each line were driven by a separate motor, they would each be independent of all the others, and any one could be used without any reference to the others.

In other cases the direction of the lines of shafting is not always the same, and motion is transmitted from one to the other by means of quarter-turn belts. In such cases, especially if the power transmitted is large, a motor would give by far more satisfactory results.

In very large works, where there are numerous buildings running in different directions and some distance from each other, it would be found that very good results would be obtained by generating all the power required for the entire establishment in one central power-house, and transmitting it to the various buildings, where it would be utilized through the agency of motors. In this arrangement, if each line of shafting were driven by a separate motor, it would be possible to run any part of any building, or the whole, so that anything from a single line of shafting up to the entire plant could be used, if desired.

From a consideration of the foregoing, it would seem reasonable to assume that the use of motors in this field will largely increase. Some work in this line has been done, but it is only a fraction of what will be done, when the advantages to be derived from the use of motors for this purpose become more widely known.

Invention of the Electromagnetic Telegraph.

To the Editor of The Electrical World:

SIR:—In general I agree with the comparison, opinions and summary contained in THE ELECTRICAL WORLD of Dec. 28, 1895, of the elaborate discussion in your columns on the invention of the electromagnetic telegraph, and also with your conclusion as to the variety of aspects the problem may assume. While the views expressed substantiate in general my opinion on the subject, yet I would like to state the case again briefly from my point of view, which in some particulars differs from your conclusions, and especially from some of the deductions of Mr. Edward Lind Morse in his paper in THE ELECTRICAL WORLD of Oct. 5, 1895. It is perhaps unnecessary to promise that my proofs are based entirely on undisputed documents and upon generally accepted facts.

1. The first complete *electric* (galvanic) telegraph *which made communication at a distance really possible* was erected in working order by Sömmering, in Munich, in the year 1809.

2. The first *idea* of an *electromagnetic* telegraph which was proved to be scientifically correct was made public in Paris in the year 1820 by Ampère.

3. The first *model* of a practical *electromagnetic* telegraph (needle telegraph) was made by Baron Schilling, at St. Petersburg, *before* the year 1832 (the correct date cannot be ascertained) and exhibited on different occasions.

4. The first *electromagnetic* telegraph by which actually and in a practical manner messages were interchanged between persons separated at a distance was that of Gauss and Weber, at Göttingen, in the year 1833, and used by them for some time. This was also a needle telegraph (galvanometer with telescope reading) and not, as incorrectly stated in your summary, an electric sound telegraph. The apparatus made in the year 1831 or 1832 by Henry consisted only of an electric call-bell. It has not been proved that Henry at that time expressed an intention to perfect this signal-sender for mutual interchange or intelligence, or that practical experiments with such an object in view were ever undertaken by him. The needle telegraph of Gauss and Weber was developed by Steinheil, at Munich, in 1836, into an audible sign-receiver with simultaneous writing attachment and a special sign alphabet, and was actually put in successful operation for the transmission of communication at the beginning of 1837, between Munich and Bogenhausen for experimental purposes.

5. For railway purposes and public communication the first electromagnetic telegraph was installed in England by Cooke and Wheatstone in the year 1840, after the model developed by Schilling.

6. Without disclaiming that S. F. B. Morse had, as early as in the year 1822, original ideas concerning the construction of an electromagnetic telegraph, yet these vague ideas, as has been proved, had no substantial result previous to the year 1837, when his oldest model with the hanging pendulum was experimentally tried. After some time he succeeded in improving this model to an extent that the resulting apparatus manufactured could actually be used for mutual communication of messages. But the first public telegraph plant was not put into working order with apparatus after the design of Morse until the year 1844.

7. Under these circumstances S. F. B. Morse can by no means be called the inventor of the first electromagnetic telegraph; aside from the dot-and-dash alphabet, the credit for the invention of which is uncertain, he is exclusively the father of the system of apparatus called after its name, which undeniably, in the course of time, was brought into common use in the telegraph service of the world, and which (writer and sounder) is of a perfect simplicity of construction; nothing more or less. And in this capacity he deserves, which I wish to emphasize once more, the highest recognition.

BERLIN, GERMANY. R. PETSCH.

Transformer Plates.

To the Editor of The Electrical World:

SIR:—Noticing the transformer controversy in your esteemed journal, permit me to state that the type shown by Mr. George Adams, in your issue of March 14, was designed by the writer and described by him in an American publication, October, 1887, and in the London *Electrical Review*, November, 1887. This type was patented in the United States, in 1889, and is used in the Lakon transformer, the Lakon Company, of Elkhart, Ind., having acquired the right of its use.

Some months ago the writer's attention was called to an English text book, in which this plate is called the "Statter." Having been in the employ of Mr. Statter, it is strange that he should allow the use of his name where it is out of place. While no monetary compensation could be asked for the adoption of that plate, no English patent having been applied for, one would think that at least the credit should be given to whom it belongs.

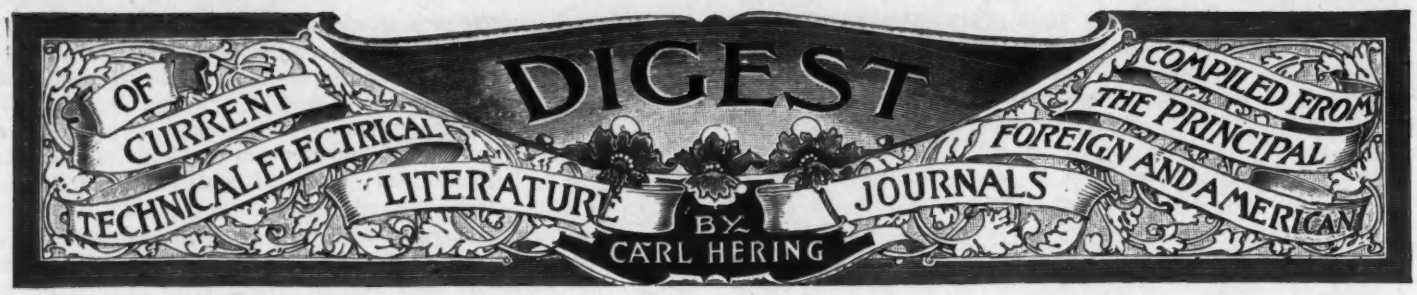
CHICAGO. LUDWIG GUTMANN.

What's In a Name.

In noticing among the names of distinguished and well-known French and English physicists those of Lannelongue, Swyngedauw, Hurmuzescu and Eumorfopoulos, we could not help thinking how it would have affected the popularity of the Röntgen rays had they been discovered by one of these; there would have been additional reason for calling them X-rays. The same applies to an English writer on electrical subjects, whose name is Pigg.

Commercial Application of "X-Rays."

We learn that in London, where honesty is not always considered to be the best business policy, a firm is making prey of the ignorant women by advertising the sale of "X-ray proof underclothing."


DIGEST
OF CURRENT TECHNICAL ELECTRICAL LITERATURE
BY CARL HERING
COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

LIGHTS AND LIGHTING.

Analytical Study of the Alternating-Current Arc. FLEMING and PETAVEL. Lond. *Elec.* and *Elec. Eng.*, March 6; an abstract of a Physical Society paper.—The first part of the paper consists of an analytical study of the distribution of light throughout the various regions in the arc when supplied with a constant known amount of power, the periodic variations of the current and the voltage being recorded; the power was measured by means of a wattmeter; the mean value of the light from any part of the arc was compared, by means of mirrors and a synchronous rotating disc, with the instantaneous value of the light taken from the same part of the arc, and taken at any assigned instant during the period; the arc itself was thus made its own standard, and the difficulties due to slow variations disappeared. The facts observed may be summed up as follows: The purple light of the true arc undergoes a periodic variation, and, as far as the eye can judge, is completely extinguished during a certain interval during the phase; it has equal maxima values during the period, at instants slightly lagging behind the instants of maximum power expenditure in the arc; on the other hand, the illuminative power of the carbon crater varies between a minimum value and two unequal maxima; the greater maximum occurring when the carbon is positive and at an instant slightly lagging behind the instant of maximum power expenditure in the arc. The second part of the paper consists of a comparison of the efficiency of the alternate-current arc regarded as a light-giving agent as compared with that of a continuous-current arc taking the same mean power. Using two arcs, which may be regarded as typical of those used in practice, the mean spherical candle-power was compared for equal expenditures of power in the arcs and it was found that for the alternating-current arc employed the total mean spherical candle-power was always less than that of the continuous-current arc; lowering the frequency seems to decrease the efficiency of the alternating-current arc. In the discussion Prof. Ayrton states that the power of an alternating arc could not be measured simply by multiplying the current by the voltage, as the current lags behind the volts; the resistance, that is, the ratio of the current and the voltage, also lags. He thought that our present knowledge was not sufficient to enable one to state definitely whether or not an alternating arc can be made as efficient as a direct-current one and he thought there was no doubt that it will be possible to get much better results than are at present obtainable. Prof. Thompson said there was a lag and not a lead, that the arc acted as if it possessed a self-induction; the resistance also lagged, which he thought might be due to a thermal lag; the temperature of the arc will lag behind the current for both increasing and decreasing values and if the resistance depends on the temperature it would also lag behind the current. He thought it was not possible from *a priori* reasoning to say whether or not an alternating-current arc could ever be obtained of an efficiency equal to that of the direct-current arc; with suitable carbons, length of arc, current and voltage, he thought it might be possible to obtain an equal efficiency. Prof. Ayrton said he had shown some years ago that even with direct-current arcs there was a certain length of arc for which the efficiency was a maximum; he considered the suggestion of a thermal lag as a valuable one. Prof. Fleming said that when so many variables were concerned it was practically necessary to restrict the investigation; they had kept the mean power constant and left the other variables to take care of themselves. Editorially it is thought that there should be no lag between the phase of temperature and the phase of intrinsic brilliancy, and that Thompson's hypothesis might be put to exact test by seeing whether a back E. M. F. in step with the intrinsic brilliancy would be sufficient to account for the observed facts; it is thought to be possible that something may happen in the arc to throw the back E. M. F. out of phase with the intrinsic brilliancy as found by the photometer. Profs. Ayrton and Fleming strongly insist on the probability that the best quality of carbons for any given lamp will depend not only on the class of current, but also on the volts, watts, and even the frequency. Before comparing two kinds of arcs it is thought necessary to discover what are the best conditions for each.

Fredureau Diffusing Globe. Lond. *Elec.*, March 6.—A brief abstract of a report by Prof. THOMPSON on these globes, which have been described and referred to frequently in these columns. They are of transparent glass, so shaped as to properly distribute and diffuse the light; they are moulded with a sharpness of surface which leaves nothing to be desired, and are quite inexpensive when their cost is compared with that of producing similar globes by cutting. With a 16-cp incandescent lamp tests were made at various angles with a lamp alone, then with a hemispherical reflector above it and then with both a reflector and a diffusing globe; the results are given in a small table; in a downward direction the results in the three cases were 8, 17.5 and 34 candles respectively; for angles increasing upward the first increased to 11.5 at 30 degrees, the second increased almost to 19 and then fell to 15 and the third diminished to 12. He concluded that the distribution of light effected by these globes is of a very real advantage; for all effective purposes a 16-cp lamp with a diffusing globe illuminates a compartment better than a 32-cp lamp not so provided, thereby effecting a distinct economy.

Studies in Hydro-carbon Flames. BIRCHMORE. *Elec. Eng.*, March 18.—A continuation of his series of articles, the present one being devoted to the spectrum and actinic effect of the Bunsen flame.

POWER AND HEAT.

Elevator. GIBSON. Lond. *Elec. Rev.*, March 6.—A reply to the article of Waygood (*Digest*, last week), in which he points out where the imitation of that elevator, as compared with the Otis, ceases, the differences, he claims, being of great importance.

Electrically Operated Turrets. L'Elec., March 7.—An illustrated description of the turrets on the *Captain Prat.*

TRACTION.

Conduit Railway System. Elek. Anz., March 1; a suggestion by RAMMELSBURG for a modification of the Diatto system (see *Digest*, Oct. 26).—He proposes abandoning the drainage system and having the contact chambers sealed by covering the top with a wooden block in the middle of which is the metallic contact piece, both being securely cemented with insulating compound in the top of the box; he proposes also to place the lower one of the two contacts on an elliptical spring so as to diminish the amount of power required to move it (it appears that the current must then go through the spring which is not good practice as an abnormal current would draw the temper). Editorially it is thought that stone or granite would be better than wood for the insulating material as the latter is apt to become conducting when on the surface of the street; it is also thought that there would be difficulties in keeping the seal perfect; also that the non-arcing alloys discovered by Wurtz might be better than mercury contacts.

Electric Locomotives. DE GRIEGES. *L'Elec.*, March 7.—A longer abstract of his recent paper, accompanied by the discussion, than the one from which the abstract in the *Digest* last week was taken; it appears to refer chiefly to the new Heilmann locomotives and a comparison with French steam locomotives.

Electricity and Steam Locomotives on Trunk Railways. BAXTER. *Elec. Eng.*, March 11 and 18; a continuation of his long article (*Digest*, March 7).—He discusses how much gain can reasonably be expected in the saving of coal; assuming that there is a saving in the coal bill of 55.6 per cent., he finds the percentage of operating expenses saved by the reduction in coal on a number of large railway systems, and finds an average of 5.57 per cent.; he deduces results based on the performance of about 200 roads, showing that the claim that locomotives consume only 50 to 60 pounds per train mile is far from being true, the average being about 80; he makes other interesting deductions from the data of these steam roads, finding among other things that with liberal calculations in favor of the locomotive the average performance exceeds 9 pounds per hp-hour; the coal bill does not constitute a large proportion of the total expenditure, and may safely be taken as amounting to 10 per cent. In the latter portion of the article he discusses the other claims of the advantages of electricity in reducing the operating expenses, with special reference to the switching engines, where the saving effected will be relatively great.

Fuse Shunts for the Magnetic Circuit-Breakers. HARRINGTON. *Elec. Eng.*, March 4.—He calls attention to the advantage of a fuse shunt over the use of a carbon break for protecting the jaws of the breaker on motor cars; it enables one to keep tally of the number of times a motorman opens the circuit-breaker; it allows of a less complicated form of construction; as the fuse will not open immediately after the circuit-breaker has operated, it enables the car to be brought to a standstill in case of an emergency reversal.

Testing Rail Bonds. Elec. Eng., March 18.—A brief description of a method which consists essentially of running two cars together and measuring the drop in voltage on the rails between them, noticing the rise in voltage whenever a joint is included in the circuit.

Testing Railway Motors. HANCHETT. *Elec. Ry. Gaz.*, March 14.—An illustrated description of a simple, practical method for systematically and rapidly testing car motors in a car barn.

Operating Expenses of English Electric Railways. Elec. Eng., March 18.—A reprint of the article abstracted in the *Digest*, March 21.

Portland, Me. Elec. Eng., March 4.—An illustrated description of the railway plant.

Staten Island. Elec. Ry. Gaz., March 14.—A brief, illustrated description of the power plant of the electric railway.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

High-Voltage Lamps and Their Influence on Central Station Practice. ADDENBROOK. Lond. *Elec. Eng.*, March 6.—The first part of a reprint of an Institution paper. He discusses the possible sources of influence on central station practice. Regarding conductors, he believes that aluminum whose conductivity is 56 per cent. of that of pure copper, will ultimately supplant the latter, but that the change will undoubtedly be comparatively slow, but it points to a reduction in the price of conductors; the cost of insulating wires is twice the cost of the conductors in the sizes usually used, and he thinks it quite possible that very important economies may be effected in this direction. Referring to high-voltage lamps he states that the results obtained so far are so good that no one can doubt that in a year or two they will become a permanent institution; he discusses the comparative values of high-voltage lamps and high efficiency lamps of the ordinary voltage; by a reduction of the current per candle-power in the proportion of 2.5 to 4, mains of a given capacity would nearly double the amount of lighting for the same expenditure of energy; by doubling the voltage the size of the mains is reduced to one quarter; therefore the mains for a station using 220-volt lamps consuming 64 to 70 watts per 16 cp, to give the same percentage loss, would not be much more than half the size which they would be if the station supplied 110-volt lamps at 2.5 watts per candle, the current being made the same in both cases; as the cost of mains forms a large proportion of the whole station cost, and as energy is cheap, he believes that even if a good 2.5-watt lamp were obtainable it would pay better to use 220-volt lamps taking nearly double the current; a 2.5-watt lamp for 100 volts has yet to be obtained, and will probably be a very difficult thing to achieve unless absolutely even pressures will be guaranteed; the opinion of the lamp makers appears universal that a 220-volt lamp of 3.5 to 4 watts per candle is more practical and attainable than a 100-volt lamp at 2.5 watts; if the latter can be made, a good lamp of 220 volts at better efficiency than 4 watts, would be forthcoming; by taking a 220-volt lamp now all the advantages of high voltage will be obtained, and in time those lamps will be made more efficient, while the high-efficiency lamp at low voltage is even now in a far less forward state of development; from this he concludes that the high-voltage lamp is the better line of the two at present; the higher voltage will always cheapen the cost of current for power purposes. Regarding the life of high-voltage lamps, he states that it can hardly be expected to obtain a life as high as that of the lower-voltage lamps, and the lamps themselves will be more expensive; he makes some deductions comparing the two, from which he concludes that the extra cost of using high-voltage lamps offers no appreciable barrier to their introduction, providing their other advantages are in excess, with which subject he proposes to deal in the next part of the paper.

Portable Electric Lighting Apparatus. PETRI; *Zeit. f. Beleucht.* Jan. 30 and Feb. 10.—He calls attention to the utility of a convenient portable plant and gives an illustrated description of a form which was found to be very satisfactory. The principles on which such a plant should be designed, are quite different from those of the usual installations; as it may have to be installed in a very short time all the parts should be as simple to handle as possible. As a source of power he recommends the steam engine in preference to benzine or petroleum motors, as the latter are not as reliable, requiring skilled labor on which the successful operation of the plant would depend; furthermore, they require quite appreciable amounts of cooling water; in steam engines any combustible material may be used, while the others require special fuel. He recommends having the boiler, engine and dynamo on the same wagon; his conclusions regarding such a plant are based on the experience obtained with different types of such plants. He recommends a tubular boiler; the engines should be as economical as possible and he therefore recommends compound engines even though the high speed makes a special construction necessary; there is no difficulty in attaining a speed of 400 revolutions; coupling the dynamo directly with the steam engine is greatly to be preferred to a belt, as being much more reliable; he recommends that there should be several circuits; he thinks a simple shunt machine is the best; for illuminating large spaces arc lamps are the best, and for most purposes six to eight lamps of 1000 to 1200 candle-power will suffice; with eight lamps a space of 480 x 60 meters can be illuminated: glass globes are not recommended as they are too apt to be broken; in preference he recommends six-sided lanterns with plain glass; parallel connection of the lamps is much more complicated than the series connection, which latter would be simpler were it not that he assumed at the start that there should be two parallel circuits; in each of these, however, the lamps should be in series. The masts for the lamps should be capable of being taken apart and should be at least eight meters above the earth; the bottom should be a cross, and they should be guyed with three wires; the masts should be made of at least two parts; for wire he recommends a thin copper wire with a vein of steel and covered with a very hard insulating material; it will save much time if the wires are merely laid over the insulators instead of having to be screwed to them, or they may be fastened with suitable hooks; the switchboard should be contained in the second wagon containing the materials; a list of the accessories is given. The Bosna railway has had such a plant in operation for nearly a year, illustrations of which are given, and it has been used with such success and has been so satisfactory that he believes important improvements either in the general design or in the execution of it are not likely to be made.

Central Stations in Germany. Elek. Zeit., March 5.—The yearly statistics published by that journal, concerning central stations in Germany; they are in the form of full-page tables giving the most important data for each station, for the previous year ending with October. At the beginning of October, 1895, there were 180 central stations in Germany as compared with 148 in the previous year; at the present time there would be about 200; there were in progress at that time 82, which is considered to show a rapid growth; continuous-current systems are still preferred and are used for about 80 per cent. of the total power of the stations or in about 74 per cent. of the stations; 73 per cent. of the continuous-current stations are provided with accumulators whose total output is about 30 per cent. of the power of the direct generators of these stations; the alternating current has kept about on a par with the previous year, while the three-phase current has made very great progress, the stations using this system being almost as numerous as those using the ordinary alternating current, while in power they have exceeded the latter. The power representing the continuous-current stations is 35,166 horse-power, while for the alternating-current stations it is 4396, and for the three-phase 4468; three-phase, combined with continuous currents, are represented by four stations of 1746 hp, and alternating current, combined with the continuous current, by two stations of 115 hp. Steam leads as the source of power, as 55 per cent. of the stations, or 82 per cent. of the power is developed by it; in 23 per cent. of the stations water-power is used exclusively, but they are mostly small—below 100 kw—their total power representing 10 per cent. of that of all the stations combined; in many water-power stations steam is used as reserve; the use of gas as a source of power is very limited, including only five stations, of a total of 265 kw. More that half of the stations have a capacity of less than 100 kw; many provincial towns and villages of less than 5000 inhabitants have central stations; there are 58 moderately large stations of 100 to 500 kw, and 23 very large ones of over 500 kw, the largest being one of those in Berlin with 3146 kw, after which comes the one in Hamburgh with 3096 kw. The number of lamps connected is about 603,000, or an increase of about 20 per cent., while the number of arc lamps is 15,396, an increase of 24.5 per cent.; the total power of the motors connected has nearly doubled, and is now 10,254, an increase of 82 per cent., part of the motors being used for street railways.

Voltage Regulator for Lights. Elek. Anz., March 1.—A brief, illustrated description of the HOPFER and EISENSTUCK apparatus for maintaining the voltage constant either at the dynamo or any other point. It consists essentially of a wire resistance, successive portions of which are brought into the circuit by means of a mercury cup which is moved up and down below the ends of the wires, each successive one of which is shorter than the preceding, and which is operated by a shunt magnet, through a system of levers which are arranged so that they may be accurately balanced by means of sliding weights.

Choking Coil and Transformers for Series Incandescent Lighting. ROTHERT. *Elek. Zeit.*, March 5.—He gives the theory of the choking coils and transformers, for a system in which incandescent lamps are run in series, each being connected to the terminals of a separate choking coil or transformer, a system used by the Westinghouse Company.

Islington Vestry. Lond. *Elec. Rev.*, March 6.—A very long, well-illustrated description of this station in London, which has just been opened, and in which fly-wheel alternators are used. The Lond. *Elec. Eng.* also contains a long, though less complete illustrated description.

Bristol Municipal Station. Lond. *Elec.*, March 6.—A long, well illustrated description of this alternating-current station, in which transformer sub-stations under the sidewalks are used; it includes a number of curves of the outputs and some data regarding the working costs.

Distribution of Power and Light from Single-Phase Alternators. MAHONEY. *Elec. Eng.*, March 18.—He describes a method which is applicable to existing stations; two alternators of the same frequency are coupled together rigidly with a phase difference of 60 degrees; from the three mains leading therefrom single-phase, monocyclic, diphase and triphase currents for operating motors and other devices, can be taken with suitably proportioned transformers; the line and the whole installation would be re-laid as if it were a three-phase alternating system, the only difference being that instead of the machines being connected in direct series they are connected with a phase difference of 60 degrees; the only change at the station is to shift the alternators, that they may be connected mechanically; the supplementary conductor would have half the

cross-section of the others, the result being that one is then able to transmit twice the power with only 25 per cent. increase of copper.

Opening a Circuit Without an Arc. Wurtz. *Elec. Eng.*, March 18.—He describes an experiment in which a small discharge across a short gap was obtained between electrodes placed in a glass tube filled with oil and securely corked; the result was that the tube broke into small fragments; he concluded from this that an arc required space, and that the expansion broke the tube; this suggested to him that if the vessel had been stronger the arc might not have been formed and that by this means a switch might be constructed for opening the circuit without an arc; he describes a number of experiments made with this view, which appear to have been only partially successful, as the oil carbonized after several thousand breaks and there was a strong leakage current.

Plant Operated by Artesian Wells. West. Elec., March 7.—A brief, illustrated description of the electric lighting plant at Chamberlain, S. D., the power for which is derived from artesian wells.

WIRES, WIRING AND CONDUITS.

House Wiring. Lond. *Elec.*, March 6.—The conclusion of the discussion of the papers of Mavor and Bathurst (see *Digest*, March 14). Mr. Boot said what was really required was a system that could be put up by any ironmonger of repute; in all wiring systems the economy was largely a question of labor as distinguished from the actual material and what was wanted was a system in which the labor was reduced. Mr. Dykes stated that the question of which was the best system of wiring was like asking which was the best engine or boiler; it simply depended on the circumstances of the case; each system mentioned was good in its proper place; he maintained that if proper care was taken with wood casings and if it was put in the proper place, as good a job could be made with it as with any other device; the trouble was not in the wire or in the conduit system, but almost always in the accessories, switches, fuses, etc., which, if they were made good, any system of wiring could be used. He maintained that if iron pipe is used it should not be insulated, for if a leak then occurs the fuse will be blown and all will be over; this means using comparatively small fuses; he thought no fuse should be used for anything larger than 5 or 6 lights; when using iron pipes he thought they should be continuously connected throughout, and earthed at one or two points; unless this was attended to serious consequences might follow. Mr. Crompton thought the most perfect system of wiring was one of those described in which there was one highly insulated wire concentric within a pipe, which at the same time formed the casing, and the return wire (he referred to the concentric system); this firm have used a large amount of this concentric wiring and have been successful; he was surprised to hear so little praise of this system by other speakers; a valuable feature was the fact that it was air-tight, every single part being closed and the insulation being kept up by preventing the entrance of damp air to the weak points, namely, those to which the fittings were attached. He thought the double-wire lamp fittings which had been in use were a great annoyance and very expensive, increasing the cost of maintaining the installation; the reason is that it was difficult to make comely fittings with so many small parts, and this was avoided by the concentric lamp fittings, which was a point strongly in favor of that system; he approved of the strong condemnation of wood casing, and thought that its days were numbered. Bathurst in a long reply stated among other things that in the system which he advocates (the interior conduit system) the conductors were not pulled in and out, except in the case of a mishap, and maintained that it was very important to be able to feel that it was possible to remove and replace conductors without any disturbances of their surroundings; he discussed the question of economy of the system; in using wood casing the casing itself was the lowest item, while labor and wire were about equal, and he advocated reducing the labor item, and perhaps the wiring item also, even if the cost of the casing or the equivalent material was thereby increased; a few figures are given; he called attention to some of the troubles incident to the use of iron pipes, among which were the effects on the insulation of the oil used in the couplings of the pipe, and the mechanical injury to the wires which were drawn in; a system of iron piping with two or even one insulated wire could not compete in price with ordinary gas piping, but this could be achieved with an insulating tube system, even if iron-armored throughout; he advocated re-lining throughout, which prevented mechanical damage to the wire, as also condensation; he called attention to the ordinary flexible cord which was used largely, and, if this was allowed, what harm could there be if wires of no better insulation were placed in an armored insulating tube in which any short circuit was rendered harmless. When centre of distribution methods were used, only ⅜ to ⅝ inch tubes need be used, as the latter could contain all wires up to 10 or 12 amperes capacity; he believed that it was already possible with this system to compete with the cost of gas piping; 25,000 incandescent lamps in England are supplied by this system. In comparing this system with that of Mavor (the concentric system), he challenged the latter to show the superiority of his system at any point, mechanically, electrically or commercially; bare joints in that system caused trouble; he never depended on solder for joining and connections; he relied on the solder only to make a connection air-tight, while in the other system solder filled a current-carrying function; he would prefer an ordinary mechanical connection under a screw head; the weak points of the concentric system he thought were lack of accessibility and the grounding of the outer wire; he preferred to have both the wires insulated at the consumer's end; he called attention to the evils of electrolysis even with an extremely low voltage.

Quick Methods for Testing for Faults in Electric Wiring. Hutchins. *West. Elec.*, March 21.—An article describing briefly how to proceed to make such tests; it does not admit of being abstracted.

ELECTRO-PHYSICS AND MAGNETISM.

Röntgen Rays. Shettle. Lond. *Elec. Rev.* and *Elec. Eng.* March 6.—He claims that the cause of the phenomena discovered by Röntgen (referring to the photographic effect of the rays) is the direct result of electric stress and not, as was supposed, of invisible light. He describes an experiment in which a cotton-covered wire "was bent five times upon itself in parallel lines" and then fastened to a cardboard and placed directly on the sensitive surface of a photographic plate; a very thin magnetic strip was fastened to the back of the plate by strips of paper, the whole being wrapped in ruby and in black paper; an alternating current of eight amperes at a frequency of 40 was passed through the wire for about 45 minutes; a complete and distinct image of the magnetic strip and the paper fastening it was formed on the plate. He claims that the "effects were the product of stress in the wire exercised through the glass plate upon the magnet and the paper." He endeavors to explain the process by which he thinks all photographs are taken; all forms of matter are polar, that is, assume a definite direction, and they are free to move in a magnetic field; owing to the terrestrial magnetism all matter exists in a magnetic atmosphere; when light, which is one of the distributing elements, falls on the sensitive surface, the molecules are thrown into motion and the general effects on the surface are the same; when it is reflected from an image the counterpart of that image would be produced on the plate; he claims that the same principle holds good in images obtained by the stress of magnetism, as the sensitive matter on the plate registers the various directions in which impressions have been conveyed to it directly or indirectly, through intermediate bodies; any body which intercepts the lines of stress modifies their effects on the plate; bodies of greater density interfere more with the lines of stress. Editorially it is thought that the image obtained by Dr. Shettle is due to electromagnetic induction and has nothing to do with the magnetic field produced by the magnet, a bar of soft iron it is thought would act equally well (from the photograph there appears to be no difference whatsoever between the poles and the middle of the magnet; also that where the paper overlaps the magnet the image is darker; the image of the magnet and the paper are about equally dark); the alternating current through the gridiron conductor would induce currents in the gelatine filament and this would cause decomposition of the salts in proportion to their intensity; the presence of the metallic bar on the back of the plate would modify the intensity of the currents in the film immediately above it (but the paper, which is a non-conductor, appears to act like the magnet, as far as causing the image is concerned).

Another article in the Lond. *Elec. Rev.* gives a brief summary of recent developments. The doubt which was expressed as to Blythswood's experiment being a genuine photographic effect has been removed by further experiment; at the suggestion of Lord Kelvin the sensitive plate was placed in a tight zinc box with an aluminum window in the lid, the box being carefully earthed and placed between the two poles of the large influence machine, which latter were two feet apart and produced a silent brush discharge; the object was placed either inside the box or outside on the aluminum window; photographs were obtained in half an hour. It is thought that the long-known electric shadows produced by influence machines may be due to the same cause; Holtz produced these shadows by using a point and a disc on his machine, the disc being hollow and covered with silk; conducting bodies between the point and the disc threw distant shadows on the silk of the disc, while insulating bodies were apparently transparent; he therefore concluded that the nature of the surface was important in determining the transparency; Lehmann found by using a disc on each electrode that a shadow of the interposed body was projected on the faces of both discs. Gossart and Chevallier made a curious discovery (see *Comptes Rendus*, 122, p. 316) which appears to add to the mystery concerning the nature of the radiations in the Crookes tube; they found that the Röntgen rays exercise a mechanical directive action on the vanes of the wheel in the Crookes radiometer; they created a field of force inside the radiometer, which is opposed to that due to the heat; the direction and intensity of the field of force around the Crookes tube was explored by means of the radiometer; it was found by experimenting with 20 substances that this force was transmitted and arrested by the same media as the Röntgen rays are; only when the radiometer was placed in the Crookes field was the field "modified by currents, especially by those of the exciting coil of the Crookes tube, modified by the presence of statically charged electrified bodies; and finally energetically distributed by a magnet"; by moving a magnet circularly about a radiometer the vanes in some way are set free and become again obedient to a source of heat; when placed in the path of cathode radiations the motion of the vanes is dampened, sometimes one pair and sometimes another taking up the axial position of equilibrium; when the current in the Crookes tube ceases the directive

action of the vanes persists for about five minutes afterward in spite of the constant action during that time of the Locatelli lamp; the vanes may be started again by directing on them the radiation from the anode, when they will at first undergo an impulsion opposite to the normal direction, which they afterward resume; the inertia effect, which lasts for five minutes, was obtained with a Ruhmkorff coil, but a Wimshurst machine failed to produce it; paraffin was found to be more transparent than air.

Henry thinks that his experiments verify the hypothesis of Poincaré that all fluorescing bodies emit Röntgen rays; a faint white image of a wire placed between a fluorescing body which had been exposed to light and a sensitive plate was produced on a dark rectangular background. Meslans made experiments to determine the influence of chemical constitution in the transparency of bodies to the Röntgen rays (see *Comptes Rendus*, 122, p. 309); he found that carbon and its compounds with hydrogen, oxygen and nitrogen is extremely transparent, but when combined with chlorine, sulphur, phosphorus or iodine, its opacity is considerably increased; he believes that the difference in the chemical constitution of the materials forming the nerves and the blood will without doubt enable photographs of these constituents of the body to be obtained by virtue of their unequal transparency. Prof. J. J. Thomson, in *Nature*, gives an account of some very interesting investigations; he tried to determine the leakage in air at different pressures; in following up his discovery that all bodies become conductors when traversed by these rays, he found that the rate of leakage is greater at a high pressure than at a low one, and for a wide range is approximately proportional to the square root of the pressure; he believes the leakage of electricity through non-conductors is considered to be due to a kind of electrolysis, "the molecule of the non-conductor being split up by Röntgen rays, which act the part played by the solvent in ordinary electrolytic solutions"; he obtained indications that the rate of leakage through air is proportional to the number of ions; he concludes that the Röntgen rays are not all of the same kind, and that their penetrative power varies greatly with the efficiency of the tube which produces them; he found that most tubes improve for a time after they are sealed off, and after attaining a maximum efficiency they then deteriorate.

According to the *Jour. des Inventeurs*, March 1, Mr. DE HEEN wrote to the French Academy of Sciences that according to his experiments the Röntgen rays of Lenard and Röntgen did not emanate from the cathode, but from the anode; to demonstrate this, one has only to place between the Crookes tube and the sensitive plate a screen of lead perforated with several holes allowing the rays to pass through; the direction of these on the photographic plate indicate that they emanate from the positive and not from the negative pole and that they are therefore anode rays.

According to the *Elek. Zeit.*, March 5, SATORI in Vienna stated that he obtained very intense Röntgen rays with a comparatively small influence machine by connecting the Crookes tube in series with a spark gap and in parallel with two condensers "whose outer coatings were short circuited," the machine gave a spark of about 12 cm; the result was not successful when the spark gap, which is in series with the tube, was omitted, probably because the voltage was then too low; that this method is much cheaper and simpler than the one usually used is self-evident, besides requiring no source of current, as the machine is turned by hand.

The paper by Mr. Perrin, noticed in the *Digest*, March 14, is published in full in the *Bul. Soc. Int. des Elec.* for February.

Present Ideas Concerning Cathode Rays. GUILLAUME. *La Nature*, Feb. 29.—He considers that the phenomena discovered by Röntgen is already becoming less mysterious and there appears a possibility of explaining it without having recourse to any new ideas; he believes that Raveau has come nearest to a satisfactory theory based on a remark of Prof. Schuster. In a previous article in that journal (July 28, 1894) Guillaume reproduced two photographs obtained by Lenard showing two spots produced by the cathode rays which are deflected and which are not deflected by a magnet; they show that the original rays consist of two distinct kinds, one of which is nearly independent of the effect of the magnet, while the other was deflected by a magnetic field into a band like a spectrum. He thinks it an established fact that the Röntgen rays are derived from the cathode rays, but are not cathode rays themselves; there is a great probability that the Lenard photographs were produced by two kinds of rays, one the true cathode rays and the others which are not deflected. There are at present two hypotheses, that of bombardment and that of radiation; that they are contradictory is not surprising if it is true that heretofore two absolutely different phenomena have been observed together. There is no doubt that Röntgen rays are essentially different from the cathode, and that they are produced at the point of impact of the original ones on a body; they diminish as the square of the distance measured from the point of impact. If the rays proceed in straight lines from the point where they are produced, it is none the less true that they do not come in a straight line from the cathode to objects exterior to the tube. He considers that the tests of the theory of longitudinal vibrations of the ether have not met with success, and he thinks this theory ought to be rejected, adding that it might be kept in reserve for the future "to be given in a still more embarrassing case." Lenard thought his phenomena might be explained by the hypothesis of very short wave-lengths; the difficulties in the way appear great, but he thinks Raveau has overcome most of them; it is known that ultra-violet radiation, which in general is very refrangible, is capable of traversing a body without being deflected or strongly absorbed; the abnormal refraction discovered by Lerous was considered an exceptional phenomenon; it consists in a reversing in the order of refrangibilities. Kundt found that many metals have an index less than unity in the visible spectrum and it is therefore natural that they possess a strong absorption and that when the band has once been passed they become more transparent; the coefficient becomes less than unity at the extremity of the band and increases again asymptotically toward unity; if it has been thought that most bodies are completely absorbent for low wave-lengths, it was perhaps due to the fact that it was not possible to produce sufficiently short waves; Chardonnet long ago showed the transparency of silver to ultra-violet rays.

Longitudinal Light. JAUMANN. Lond. *Elec.*, March 6; the first part of a translation of a paper from the *Wied. Ann.*, 51, p. 147.—The style is somewhat brief and not very clear. He gives results of experiments concerning the nature of light in a vacuum and of cathode rays, accompanied by a theory of electric phenomena in rarefied air, which he considers makes cathode rays and kindred phenomena perfectly intelligible. The first part refers to the determination of the direction of vibration of electric rays, which direction he states may be determined by discharge experiments; he gives what he calls a discharge law and shows how it can be used for determining the direction of vibration of cathode rays and of light in rarefied air; he claims to have given an experimental proof of the longitudinal character of cathode rays founded on the discharge effect of these rays; as they have a strong discharge effect he claims they are electric waves of great amplitude; they also have a strong discharge effect when their direction is perpendicular to the electrode surface and hence the direction of their electric oscillation coincides with their direction of propagation; "they are rays with a great longitudinal component, and, therefore, from symmetry, essentially pure longitudinal electric rays."

Movable Light Phenomena in Rarefied Gases Caused by Electric Oscillations. ELSTER and GEITEL; *Elek. Zeit.*, March 5; abstracted from the *Wied. Ann.*, 56, p. 733.—They describe experiments from which they conclude that cathode rays are not due to a bombardment of particles detached from the electrode, but are movements of the ether analogous to light, that is, to what Jaumann calls longitudinal light.

Resistance to Alternating Currents. BRYLINSKI. *Bul. Soc. Int. des Elec.*, February.—A communication referring to the recent paper of Mascart (*Digest*, Feb. 8 and Jan. 18). He gives a formula for finding the increase in the (apparent) resistance (due to the frequency) of copper wires of any given diameter for a frequency of 80; after reducing the formula of Mascart to the same form, he compares numerical results obtained from both of them for various diameters, with the results in the table of Lord Kelvin, showing that his (Brylinski's) formula gives closer results, although the other is sufficient for practical purposes. He then discusses the subject of iron wires, coming to conclusions which are quite opposite to those arrived at by Mascart; he finds that the increase of resistance produced by high-frequency currents in iron wire appears to be the only reason why it is impossible to use iron for long-distance telephone lines, while Mascart concluded that iron wire was better, all other conditions being the same; he takes a numerical example assuming the permeability to be about 100, according to Massin, and finds that the increase of resistance is much greater than for copper; in a table he gives the effective resistances of various iron wires for the frequencies corresponding to certain sounds of the human voices.

Experiment with an Incandescent Lamp and Magnet. SALOMONS. Lond. *Elec.* and *Elec. Eng.*, March 6; a brief abstract of a Physical Society paper.—When an incandescent lamp through which an alternating current passed, was brought near a continuous-current magnet the filament was found to be set into vibration; if brought sufficiently near, the vibrations were sufficiently intense to break the filament; the number and position of the nodes formed were found to be independent of the natural period of the filament, but depend on the frequency of the alternating current. Prof. Ayrton suggested that the magnetic leakage was very large in that experiment and wanted to know whether this method was more sensitive for mapping out the field than those ordinarily employed; he thought that the natural period of the filament would to a certain extent influence the results; he called attention to some measuring instruments in which a similar principle was made use of. Salomons replied that the arrangement was not intended for making measurements; the character of the vibrations remained unaltered for many hours; he found the vibrating filament useful for microscopic work, where a surface rather than a line of light was required.

Röntgen Rays.—The *Elec. Rev.*, March 11, contains an interesting article by Mr. TESLA, giving his views and results obtained by him, including a large reproduction of a photograph of the shoulder of a man, showing the ribs and upper arm bones taken at a distance of 4 feet, and another showing a clear image of wire taken at a distance of 11 feet. His experiments were directed toward investigating the nature of the radiations and to perfecting means for their production; their intensity depends on the intensity of the cathode streams, and he concludes that the

highest obtainable electric pressure is therefore desirable; the best results would therefore be obtained by using the disruptive discharge with which there is practically no limit to the spark-length, the only requirement being a certain knowledge and skill in the adjustment of the circuits, particularly as to resonance. By having two electrodes in the same bulb the potential is limited and one is therefore lead to the use of a single electrode bulb, the other terminal being as far away as possible; an inside terminal should be used as tubes without such terminals are much less efficient on account of loss through the glass; it is an error to suppose that concave electrodes will concentrate the rays; they are if anything a disadvantage. Regarding the vacuum, he calls special attention to an electrical method of rarefaction which may be used to any degree desirable, and gives a vacuum far beyond that obtainable by any mechanical appliances; although this can be done by means of a static machine, a disruptive coil is far better; after exhaustion with an ordinary vacuum pump, the bulb is attached to the disruptive coil, and there will then be at first a milky light throughout the bulb, and the phosphorescence of the glass, which subsides quickly, and a white light then settles around the electrode, a dark space forming at some distance from it; the light then becomes reddish and the terminal grows very hot, requiring careful regulation to prevent it from being consumed; after this the light again becomes white and gets weaker and weaker until the streams finally disappear, the phosphorescence growing more intense and the spot where the stream strikes the wall becomes very hot, the phosphorescence around the electrode ceases and it becomes quite cool; the gas in the tube has then reached the required degree of rarefaction; the process may be hastened by repeated heating and cooling and by the use of a small electrode; bulbs with external electrode may be treated in the same way; whenever the electrode is as hot if not hotter than the glass, it is a sure indication that the vacuum is not high enough or that the electrode is too small; as a cooling medium he found it best to use jets of cold air, thus enabling one to use very thin tubes. He thinks the opacity of the glass and transparency of aluminum have both been somewhat exaggerated. He believes that there is an actual expulsion of the particles through the walls of the bulb; he is becoming more and more convinced that the phenomena is due to a stream of material particles which strike the sensitive plate with a great velocity; based on an estimate of Lord Kelvin, he believes that with very high potentials the speeds are as great as 100 kilometers a second. Even an ordinary stream under a great pressure passes through a thick glass plate as though it were not there; from a low to the highest frequency obtainable there seems to be no difference in the quality of the effects produced except that they are more intense when the frequency is higher, which he thinks is due to the fact that the maximum pressures of the cathode are then also higher; this is on the assumption that the effects on the sensitive plate are due to projected particles or else vibrations far beyond any frequency which can be obtained by means of the condenser discharges; the fact that the opacity of a body bears some relation to the density speaks strongly for the material streams; strong impressions on the plate might be arrived at by perfecting plates especially sensitive to mechanical shock or impact; this may lead to the abandonment of the present plate. He has obtained remarkable impressions with the apparatus described; shadows may be obtained at distances of many feet while at small distances and with thin objects an exposure of a few seconds is sufficient; he hopes to be able to magnify the effects many times; with a rabbit exposed for one hour, not only the skeleton was visible, but there was also a clear outline of the abdominal cavity, the location of the lungs, the fur and other features being also shown; images of human limbs are obtained in a quarter of an hour to an hour; metallic objects and bony or chalky deposits can now be invariably detected in any part of the body; an outline of the skull is obtained in 20 to 40 minutes, the latter showing the cavities of the eye, and the chin, cheek and nasal bones, etc., as also the flesh and even the hair; the action of the rays on the head appears to cause a feeling of drowsiness, a sensation of warmth and a general soothing effect. It may be possible, he thinks, by these strange appliances to project a suitable chemical into any part of the body. The issue of March 18 contains a further contribution from the same author. After making a few corrections in his former article, he states that he is now producing strong shadows at a distance of 40 feet and even more, with "the possibility not to say certitude of augmenting the effects with my apparatus at least ten-fold"; he attributes the effects of this great distance to the use of a bulb with a single terminal which permits the use of practically any desired potential and the attainment of extraordinary speeds of the projected particles. He also obtained shadows by reflected rays only, thus demonstrating that the rays possessed this property; a thick copper tube was used at the one end of which the plate holder was placed, while at the other, open end, there was a thick plate of glass at an angle of 45 degrees above which was the bulb; a clear, sharp shadow was produced with an exposure of 45 minutes; he satisfied himself that no action would be produced through the copper tube; he also found that approximately 2 per cent. of the rays were reflected. He is finding more evidence in support of the theory of moving material particles and is arranging some crucial tests; a fairly exhausted bulb containing the electrode connected to the disruptive coil produced small streamers breaking through the sides of the glass, producing a fine hole through which, however, the air does not rush into the tube; the glass in the neighborhood of the rupture may grow hot enough to soften but it will not collapse but rather bulge out, showing that the pressure from the inside is greater than that of the atmosphere; as the matter is expelled from the bulb the rarefaction increases and the streamers become less intense, whereupon the glass closes again, hermetically sealing the opening; he thinks this a positive evidence that matter is being expelled through the walls of the glass.

The same journal contains brief extracts from articles published in daily papers, among which is one stating that Edison found that he could see with the naked eye all the bones of the hand, also moving objects through eight inches of wood; he states that it makes a great difference who does the glass blowing for the bulbs, as the nature of the breath of the glass blower is said to make a difference.

The *West. Elec.*, March 21, contains an article by Mr. Jones in which he expresses the belief that there is an analogy between ordinary light and this new radiation; the latter seems to be made up of many different rays which differ widely in penetrating power, just as white light is the sum of rays of various wave-lengths; the time of exposure decreases with the rise in voltage, but lower voltages will also produce radiations; a sheet of aluminum is fairly opaque to low potential radiation but quite transparent to those produced by higher voltages; he thinks his experiments justify the theory that Röntgen rays vary greatly in penetrating power and that the voltage at the tubes plays a similar part to temperature in producing light rays, new waves being excited as the temperature rises; he is carrying out further experiments. His results also indicate that each ray requires a definite time to produce its maximum effect; an experiment is described showing that particular rays produced their maximum effect in 5 to 15 minutes and that a longer exposure was useless.

E. P. Thompson, in the *Elec. Eng.* and *West. Elec.*, March 7, describes an application of the X-rays for seeing objects in motion; with the apparatus referred to in the *Digest*, Feb. 29, he saw the motion of the bones of the fingers when bent backward and forward; he believes that with this apparatus the skeleton of a fish could be seen in the act of swimming; he thinks a fracture in a limb could thus be made visible by bending or stretching the limb; another experiment showed the effect of a solid passing through a solid, which suggests a possibility in surgery where it is desirable to follow the point of the instrument through the flesh. He finds that certain precautions are necessary in preparing the fluorescent screens; when the barium platino-cyanide is crystallized on a sheet of paper, or if the crystals are pressed on the surface, the screens are of little use; excellent results were obtained when the cyanide was powdered as finely as possible and applied with the clearest colorless varnish on a piece of tracing cloth, to the depth of about one eighth of an inch, care being taken not to make it too thin; either side of the screen may be directed toward the tube; it is important to perform the experiments in a dark room.

The *Elec. Eng.*, March 11, contains an article by Prof. Stine in which he covers partly the same ground as in the article abstracted above. He considers that his experiments strongly confirm the theory of longitudinal vibrations; he has not been able to detect that the light speed of dry plates has an influence on the time of exposure to the X-rays, and he now prefers slow plates, as they give clearer shadows; an experiment seems to indicate that ultra-violet rays have nothing to do directly with the phenomena; he appears to think that fluorescence is not the cause of the photographing action; the anode and cathode streams seem to be identical; he tested many incandescent lamps as bulbs for producing these rays, and found only one that would answer, from which he concludes that the vacuum is too low; he obtained some negatives of tourmaline, which he thinks proves that the rays are not transverse in character, and that the ultra-violet wave theory can no longer be entertained. He calls attention to the difference between such photographs and the so-called "electrographs," which latter he thinks are the result of an electrolytic action on the silver salts; he considers that the cathode is the prime source, but that the fluorescent bulb is a secondary source; the yellowish-green fluorescence is thought to be due to the uranium in the glass; he made other experiments with uranium to find whether it was the cause of the rays, and did not obtain the slightest effect; the Crookes tubes should have an extremely high vacuum, so high that there is only a faint trace of purple light around the anode; a successful tube shows a green fluorescence, while in those that failed it is yellow; a tube improves with use; he thinks the photograph is not the result alone of molecular bombardment, but rather of the nature of electrolysis; the seat of the effect may be in the molecules containing a charge of static electricity and vibrating with a frequency of green fluorescence or ultra-violet light.

The same journal contains an article by Prof. Elihu Thomson on manifolding by cathode rays, that is, producing simultaneously a number of impressions; he placed 24 layers, mostly of sensitized printing paper, over the plate, taking a photograph through them all; there was a strong impression on the glass plate and a weaker though perfectly distinct one on each of the bromide paper layers; a number of the printing papers were not impressed; he concludes that the experiment shows that the plates should have dense thick films, rich in sensitive substances such as bromide of silver, "or that the proportion of material in a plate highly sensitive to cathode rays is not great"; he thinks the film on some of the

papers was not sufficiently thick; he thinks he found indications that in cathode pictures there is a complete detail present and that an intensifying process need not fail to bring out detail.

Mr. FREEDMAN, in an article in the same journal, describes experiments made with arc and sunlight, proving that no Röntgen rays are present in these sources; the shadow picture of a screw-driver showed the handle as well as the iron equally dark, while if it had been the cause of Röntgen rays the iron would have shown in the handle; such pictures are therefore due to the filtration of ordinary light; other proofs are given; an aluminum slide produced no results while hard rubber did.

In the same journal Mr. FROST shows a photograph of a magnet which contains lines suggesting lines of force, but he is not sure that the lines shown are really lines of force; ordinarily magnets exhibit the usual metallic obstructions without any of these markings. Mr. R. K. DUNCAN exhibits some images which were obtained from electric discharges in air, and he thinks the results are simply due to electrolytic action. Mr. COTTRELL in an article on ultra-violet rays and lamps adapted to produce them, describes briefly some early experiments of Stokes and Crookes, and states that his experience of several years leads him to conclude that whether the lamps are intended for shadow prints or luminous effects, they should "be constructed on the principle of an electric condenser; the subjecting to the action of a varying electromagnetic or electrostatic field; of one condenser surface exposed to the vacuum of an exhausted receptacle and another condenser surface exterior to such receptacle and exposed to air"; he thinks it best to use a thin, spherical bulb with a carbon or an aluminum terminal, the latter being better than platinum.

In the issue of March 18 Prof. ELIHU THOMPSON confirms the discovery of Rowland by stating that on examination he found that in his apparatus it was the anode from which the rays emanated; he describes another experiment proving it, which consists in screening the rays from the anode and he has no doubt that they do emanate from the anode. In the construction of such tubes he thinks it desirable to seal in a small piece of aluminum as an anode and a somewhat extended cathode disc of the same metal, besides a third terminal of sheet platinum, the object of which is to adjust the vacuum; by the use of this third terminal, with discharges passing therefrom, such an amount of platinum may be deposited on the glass that will bring the vacuum to the desired point which is just short of that which makes the vacuum insulating in character. In the same journal Mr. R. K. DUNCAN describes some experiments showing that shadow pictures obtained from ordinary illuminants are not due to X-rays.

The same issue gives an extract from a Cambridge Philosophical Society paper of Prof. J. J. THOMSON; he discusses the theory of longitudinal waves from the point of view of the electromagnetic theory of light and shows that the former can exist in a medium containing moving charged ions and in any medium, provided the wave-length is so small as to be compared with molecular dimensions and with the ether in the medium in motion. In one of the experiments with Röntgen rays the photographic plate was placed inside of the vacuum tube between the cathode and the walls and it was found that the plate was not affected, from which he draws the conclusion that the fluorescence of the glass is necessary to produce these rays (provided they did not emanate from the anode); he finds furthermore that both a cathode and a fluorescent substance are required for the production of these rays and that one without the other is inoperative; in some photographs with tourmaline plates crossed and parallel no difference could be detected in the obstruction offered to the rays; referring to some recent experiments of Elster and Geitel he states that although they are not conclusive yet they are in favor of the vibrations being longitudinal.

According to the *West. Elec.*, March 7, a Röntgen photograph of a thigh was recently taken by Dr. BURRY and Mr. SCRIBNER, which showed that a portion of the bone midway between the knee and the hip joint two inches long and an inch wide was entirely gone and its place filled with a spongy growth; the operation showed that sarcoma had attacked the bone.

The same journal also contains an article by Prof. STINE describing further experiments made by him. He believes that the fluorescence in the Crookes tube is due to the uranium present in the glass; he discusses the question of whether molecules containing uranium and vibrating with a frequency of light will directly generate the ray. He thinks that the hypothesis that the "sciagraph" is due to a species of electrolysis, more fully explains the evidence which has accumulated, than any other theory. Successful tubes, he states, show a decidedly green fluorescence while in inactive tubes it is decidedly yellow; an active tube rarely shows any purple cathode or white anode light and the tube grows more active the less this light is; the tubes increase in efficiency with use, the purple light growing fainter.

In the same journal Prof. CARHART calls attention to the fact that after a Crookes tube had been used for half an hour its resistance appears to increase greatly so that it almost ceases to fluoresce and sparks pass over the outside; if after the anode had become fatigued the current was reversed, the fluorescence was again bright; it seemed to him that it was the anode which appeared to fail, as far as the fluorescence was concerned; experiments seemed to indicate that a tube with an exceedingly high vacuum such as this appeared to have after a half hour's use, would give better results than ordinary tubes.

An article by Prof. STINE in the same journal gives a number of illustrations of "sciagraphs" and electrographs, calling attention to their difference; by electrographs he appears to mean those produced by the direct action of influence machines; he believes that no true Röntgen photographs have been produced by other agencies than the electrified Crookes tube. The *West. Elec.*, March 14, contains a reproduction of a Röntgen photograph of a rattlesnake, a fish and a small shrew, as obtained by Messrs. LEEDS and STOKES; they prefer to stop down the rays by means of lead diaphragms having circular holes from one quarter to one inch, as they then obtain a sharper definition; they prefer to use a tube, one end of which is made of uranium glass exactly under one of the electrodes. It is also said in that paper that, according to Prof. SMITH, incandescent lamp bulbs may be used although the results are far inferior in strength and clearness; he used an influence machine in the usual way by connecting the tube between the outside coatings of the Leyden jars. The same journal reproduces a photograph obtained by Röntgen himself, which was published in the *Yale Medical Journal*, and shows a "vicious union after fracture" of the left forearm.

The translation of the article by Prof. SALVIONI, abstracted in the *Digest*, March 14, is reprinted in *El'ty*, March 11.

Heating Effect of Oscillations. KLEMENCIC. *West. Elec.*, March 21.—A translation of the article, with the illustrations, describing the apparatus for demonstrating the heating effect of electrical oscillations in wires, which was noticed in the *Digest*, Nov. 9.

Electromagnet for Lifting Purposes. West. Elec., March 21.—A reprint of the description noticed in the *Digest*, March 7.

ELECTRO-CHEMISTRY AND BATTERIES.

Blot Accumulator. D'ARSONVAL. *Bul. Soc. Int. des Elec.* February.—A reprint of the complete paper, with illustrations, which was abstracted in the *Digest*, Feb. 15.

Electricity from Coal. JACQUES. *Elec. Rev.* and *Elec. Eng.*, March 11.—A brief extract, with an illustration, from a recent patent. The apparatus is a modification of the Jablockkoff form; he uses caustic soda, the soda vehicle acting as a carrier of the oxygen of the air, which is forced through the fused soda; the iron container maintains the soda in fusion at about 900 degrees F.; the electrolyte should be thoroughly impregnated with oxygen by admitting air under pressure in the form of fine sprays; the electrolyte should also be in constant circulation; the temperature of all the parts should be kept uniform throughout; a portion of the carbonic acid formed combines with some of the caustic soda to form a carbonate, which, together with the ash from the carbon, slowly contaminates the electrolyte, which must therefore be drawn off occasionally and replaced by fresh material.

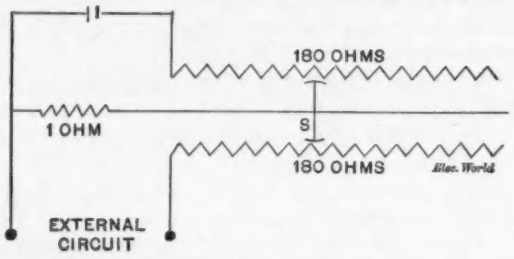
Indirect Electrolysis. ANDREOLI. *West. Elec.*, March 21.—A reprint of the article abstracted in the *Digest*, Aug. 23, 1895.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Condensers. D'ARSONVAL. *Archives d'Elec. Med.*, Feb. 15.—A short article giving hydraulic analogies to explain the action of condensers in multiple and in series, and deducing from them a simple method for measuring high potentials, such as those of influence machines. An electric condenser may be said to be analogous to a vessel for a liquid; the capacity is proportional (for unit pressure) to the area of the base expressed in square centimetres; taking two such vessels of different sizes, he shows that when connected with a reservoir at the same level and then emptied, the energy will be equal to the volume multiplied by half the height, and will therefore be proportionally greater as the cross-section is greater; if n such jars be connected together in quantity, the energy stored will be proportional to their number. If, however, the same quantity of water is poured into both, the height in the smaller will be proportionately greater. For both the electric condenser and the hydraulic analogy at a constant potential or level, the energy of the discharge is proportional to the capacity; while for an equal electric or hydraulic mass the energy is inversely proportional to the capacity. To show the connection of condensers in cascade, that is in series, he uses as an analogy two U-shaped tubes, partially filled with mercury, one arm of the one being connected with one arm of the other by an inverted U-shaped tube filled with a liquid without weight; if one of the free arms be connected to the source of pressure, the change of level will be equal in both, but only half as great as if only one had been used; the volume of the mercury displaced will be n times less if they are n tubes thus connected, and the change of level will also be n times less; the energy in each tube will be n^2 times less, and as there are n tubes the total energy of all of them will be n times less than with a single tube. If a certain volume of the liquid is introduced in one of the branches, the change of level will be the same in every tube whether there are one or more, and the energy will be proportional to the number of tubes; that is, for an equal electric or hydraulic mass the energy of the series will be proportional to the number of elements. The laws when connected in multiple are therefore precisely the reverse as when connected in series; when in series they form a reducer of the potential proportional to the number of elements; if therefore a certain number are placed between the poles of an influence machine, the potential at the terminals of one of them will be n times less than the total, and if the number is sufficiently great such a method will enable one to measure the voltage of an influence machine by means of an ordinary electrometer. As it is not convenient to make so many condensers and have them all

exactly alike, the same result may be obtained by having only two condensers in series, but of different capacities; applying his same hydraulic analogy, he shows that when a tube of small cross-section is connected with one having a very large section, say 100 times as great, and if a pressure is applied to the small one, the change of level will be 100 times as great as in the large one; if therefore two condensers are connected in series, one having a capacity 100 times as great as the other, the voltage at the terminals of the large one will be 100 times as small; on this principal he based measuring instruments for use in electrotherapeutics. To measure the output of influence machines he makes the "inactive" pole of the machine a point and places in front of it an anemometer, which measures the output of the machine by the intensity of the electric wind which is produced; he states that this is a very sensitive method, which is better than using galvanometers; he intends soon to publish the very simple relations which connected the output of the machine in coulombs with the velocity of the electric wind.

Variable Resistance. Rev. de L'Elec., Feb. 29.—Under the heading of "A Reducer of Potential," an illustrated description is given of an instrument made in Switzerland, to be used chiefly for electrotherapeutic purposes for varying the current strength in a circuit; the arrangement, however, is applicable also to variable resistances in general. The accompanying diagram shows the disposition of the resistances and explains



itself; the device consists essentially of two resistances with sliding contacts, one of which is in series, while the other takes the part of a sort of potentiometer wire to cut down the available voltage; *S* is a sliding contact which moves over these two resistances, and is connected to the other pole of the battery or external circuit through a small resistance, the object of which is apparently to prevent the source from being short circuited by that branch connection; the current in the external circuit will be greatest when this sliding is in the extreme left-hand position, and it will be least when in the extreme right-hand position; by having 180 ohms in each of the two main resistances, it is stated that the whole resistance may be varied between zero and 180 squared.

Apparatus for Varying the Self-Induction. Wien. *Elek. Zeit.*, March 5; abstracted from the *Wied. Ann.*, 57, p. 249.—He describes an apparatus which, though not new, is very convenient in practice and enables a self-induction to be varied continuously from 4×10^5 to 1.2×10^8 cm, which is sufficient for most measurements. The apparatus consists essentially of a fixed and a movable coil, which are connected in series, the movable one being inside of the stationary one and capable of being turned through 180 degrees; the fixed coil is made of a number of independent windings connected to binding posts by means of which they may be variously connected, the intervening gaps between these steps being obtained by moving the inner coil; a horizontal scale by means of which the deflection of the inner coil may be measured, is provided; the apparatus is calibrated by Maxwell's method, with alternating currents and a Wheatstone bridge, by comparison with coils of known self-induction. The same apparatus may be used for measuring the capacity of condensers with or without leads, as also the self-induction coefficient of all lines.

Direct Reading Platinum Thermometer. Appleyard. *Proc. Phys. Soc.*, March.—The beginning of a reprint of the complete paper, with illustrations, which was abstracted in the *Digest*, Dec. 28.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Simultaneous Telegraphing and Telephoning. Elek. Anz., March 1.—A brief anonymous article in which the conclusion is reached that in general there are two possible methods for using telegraph lines for telephones also; the first is to construct a single line of two wires, which line is used as one telegraph line and one telephone line; in this case no special apparatus is necessary other than an induction coil at each end, wound with three different wires. In the second method three lines are made of two wires, two of which are for telegraphing and one for telephoning; in this case special apparatus is necessary. Which of these methods will be used in future cannot be predicted.

Automatic Telephone Station. Zielinski. *Elek. Zeit.*, March 5.—An illustrated description of a system used in Germany, the object of which is to make central stations automatic during the night.

Iron Wire for Long Distance Telephoning.—See abstract on *Resistance to Alternating Currents.*

MISCELLANEOUS.

Poplar Trees as Lightning Rods. Hess. *Elek. Zeit.*, March 5.—He continues the discussion of the subject and comes to the following conclusion: That poplar trees form a point of attraction for the lightning; the protective action of poplars on neighboring buildings is dependent very largely on local conditions; as effective lightning rods are only those in which the branching extends to near the bottom of the tree and when they are planted in thoroughly wet ground, as also when there are no metallic parts of the building in the neighborhood of the tree; if the tree is in dry ground near a wall of a building which contains a reservoir of water or is in damp ground, the probability of the lightning jumping to the building is very great; high poplars with few branches nearer than two metres of the building form a danger to lightning which is greater the shorter the branching part of the tree and the closer they are to the building; the danger of ignition to the building is greater, the greater the distance between the tree and the point of attraction in the building. In order to make these trees good lightning rods he suggests providing the lower parts of them with an iron rod which leads to moist ground; the best of all is to provide the building with a proper lightning rod, but if this is too expensive there ought at least to be a metallic rod along the edge of the building nearest the trees, which is carefully earthed; if this is too complicated the trees in the neighborhood of the building should be cut down.

Electricity in Relation to Dentistry. Guy. *Elec. Eng.*, March 18.—A reprint in abstract of a short paper.

New Books.

The Intellectual Rise in Electricity. By Park Benjamin, Ph. D., L.L.B. New York: D. Appleton & Co., 1895. 611 pages. Price, $4.00.

This work is intended for the general reader rather than for the technical electrician, and the author has, therefore, according to his own statement, "rigidly excluded all technicalities and scientific demonstrations." He has, however, used such modern ideas as "field of force," that assist the reader in looking at ancient theories and experiments from a modern standpoint. The title of the book calls up memories of Draper's "Intellectual Development of Europe," and there are some passages, especially those where the author philosophizes on the actions of men under given conditions, which seem to faintly reflect the spirit of Dr. Draper's book. But such resemblances are only superficial, for the two books differ fundamentally in that while Dr. Draper's was written to prove a theory, Dr. Benjamin's was compiled with a view to bringing into a continuous narrative, so far as possible, the widely scattered facts in the history of electricity, and any theories advanced or conclusions drawn are of a subordinate nature, and somewhat of the character of afterthoughts.

Beginning with the earliest recorded observations of the attractions of the loadstone for iron and of rubbed amber for all light bodies, the history of the electrical and magnetic knowledge is brought down to the time of Franklin. Whether the reader agrees with the author or not in his opinions and conclusions, he must perforce admire the author's industry and perseverance in working over immense amounts of irrelevant matter to trace the slender thread of electrical discovery. In fact, so slender is the record that at times it disappears altogether. Thus, as the author himself remarks, the compass was in use for years before anything was written about it, for in those times the literary men were almost exclusively ecclesiastics, and they, for the most part, knew nothing whatever of maritime matters, and, on the other hand, seafaring men who used the compass kept their knowledge secret.

All history has an element of uncertainty, but this particular history seems to be especially uncertain. For instance, in one of the author's former books, "The Age of Electricity from the Amber Soul to the Telephone," he says: "Inasmuch as all these acted like amber, Gilbert called them electrics . . . deriving the term for the Greek word for amber, *elektron*." Later, in his well-remembered controversy concerning the late badge of the American Institute of Electrical Engineers, Dr. Benjamin, utilizing the knowledge obtained by a deeper study, says: "What he (Dr. Gilbert) did do was to give the name 'electrics' to certain substances, which he, for the first time, discovered would attract light bodies and which act, as he says (not 'in the same way as,' as Mr. Mottelay translated him), but, 'for the same reason as' the amber." In the present work, after still more research, the author translates Gilbert's Latin phrase thus: "Those substances which attract in the same manner as the amber." Again, in the aforesaid controversy, Dr. Benjamin says: "Gilbert derived the word not from the Greek *elektron*, but from the Latin *electrum*. Whether the Latins took their word from the Greek is a question. The original Latin word for amber was *succinum*, meaning sap, but it is argued by some writers that the term *electrum* became applied to amber because of its resemblance to the brilliant colored alloy of that name." In the present work, the author says, "Gilbert's treatise being in Latin, he frequently translates the English word 'amber' by the Latin 'electrum,' a derivative from the Greek ἠλέκτρον (*elektron*.)"

The author's opinion on this point exhibits an alternating potential, but perhaps the oscillations may be damped out, after a few more reversals, by judicious management.

One of the interesting conclusions of the book is that in regard to the origin of the compass. The author takes the ground that the compass

was discovered or invented by the Finns, and that the knowledge of it spread from the city of Wisbuy, on the Island of Gottland in the Baltic Sea, which was the great gathering-place for seamen of all nations. The theory that Marco Polo or any one else brought the knowledge of the compass from China or other Eastern country to Europe is considered untenable.

There are several errors of a subordinate or minor nature in the work, of which the following are samples. On pages 182 and 183 we find these remarks: "The presence of the little needle of copper or silver which Peregrinus thrusts through the pivot at right angles to the iron needle is a matter of curious interest." "Yet currents generated in a non-magnetic conductor moved in a field of force, cause it to seemingly meet resistance. . . ." "The non-magnetic needle in Peregrinus' compass may have had the same effect." Those instruments in which the dampening effect of eddy currents is utilized are so constructed that a closed path is provided, with E. M. Fs. in its different parts, which do not neutralize, but assist each other. Any horizontal needle, or, for that matter, a disc revolving in its own plane, will have a difference of potential between its centre and periphery, due to the vertical component of the earth's field, but no return path and no current to exert a damping action. The author's mistaken criticism of Peregrinus' statement, on page 174, "You will infer what part of the iron is attracted to each part of the heavens, from knowing that the part of the iron which has touched the southern part of the magnet turns to the northern part of the sky," has already been noticed in this journal, page 58 of the current volume.

In more than one instance the screening of electrostatic induction is called electrical insulation. On page 249, we read, "The amber does not move chaff when something is interposed; the magnet nevertheless will attract iron." This is quoted from Cardan. The author then says: "It was to be a rejuvenated world that Cardan thus brought the first suggestion of electrical insulation." It may be claimed that this work, being a popular one and technicalities being purposely avoided, the phase "electrical insulation" answers all purposes; but on page 310, in speaking of Gilbert, the author says, "Hence he discovers that to cut off attraction completely, it is necessary not merely to interpose silk texture midway between the electric and the object, but quickly to lay it over the electric directly after friction. This is the first suggestion of insulation applied directly to the charged conductor—the prototype of the coating which covers the wires which convey the current through our streets and dwelling, and prevents leakage of them on the one hand, while guarding us from their dangers on the other." Here is a direct misstatement, which cannot be allowed even on the plea of avoiding technicalities. To begin with, Dr. Benjamin has a little before this informed us that Gilbert called insulators "electrics," and in this he agrees with all other historians, so that the rubbed "electric" can scarcely be called a "charged conductor," even for the purpose of constructing an analogy for the popular reader's delectation. Again, the "electric," being itself an insulator, the additional insulation offered by a silk fabric would be insignificant. What Gilbert probably meant was that he replaced upon the rubbed "electric" the identical silk fabric with which he had done the rubbing, and as this had (as is now well known) an equal charge and of opposite sign to that of the "electric," the electrostatic induction would, of course, disappear. This opinion is strengthened by the fact that Gilbert says "quickly" "directly after friction," for the silk, if held in the hand, would soon lose at least part of its charge, and if then replaced would not neutralize the electrostatic induction of the "electric."

These errors do not affect the historical value of the work, which is measured by the diligence with which the author has searched all available records, rather than by the remarks let fall in the course of the narrative. The volume is interesting reading, and contains much information for the general reader who takes an interest in electricity. The mechanical execution of the book is excellent.

CONTROLE DES INSTALLATIONS ELECTRIQUES AU POINT DE VUE DE LA SECURITE. Par A. MONMERQUE. Paris: Baudry et Cie. 494 pages, 185 illustrations. Price, 10 francs.

The object of this somewhat elaborate work is stated in the preface to be, on the one hand, to inform electricians interested of the various governmental regulations concerning the distribution of electricity, and, on the other hand, to guide government electrical inspectors in the discharge of their duties, the indications given being designed to avoid conflict with electrical, while at the same time safeguarding public, interests. The author is a government official, and the work has received the official endorsement of several governmental departments.

While the work has thus a very special character, and more than a quarter of its contents are devoted to reprints of government regulations, it yet contains much information of general electrical interest. The principal criticism of the book may indeed be based upon this latter fact, as an attempt has been made to include within its pages a summary of nearly all electrical knowledge. The first 126 pages, for example, consist of the usual text-book development of electrical principles, and in succeeding chapters similar matter is plentifully distributed. Were the matter having a direct bearing on the subject of the volume separately printed it would probably not exceed over 50 pages, exclusive of government regulations. The book, it is scarcely needful to say, would have but little value to American readers except for comparative purposes.

A New Type of Transformer.

There has recently been placed upon the market by the Louisville Electrical Works, of Louisville, Ky., a new type, known as "Style N," of their well-known Phœnix transformer, and which is made in sizes ranging from 20 to 250 lights in capacity. This style of transformer is illustrated in Figs. 1 and 2, the detached fuse-box used with it also being shown in Fig. 1.

The transformer core is composed of four interchangeable L-shaped sections, each built up of thin plates firmly pressed and bolted together between heavier end-plates. The portions of the core-sections which make contact with each other are planed off true and smooth. When the core-sections are firmly clamped about the coil, absolutely true, smooth and permanent magnetic joints are made. The bolts which are used to clamp the core together pass through holes drilled in the back of the case, and by means of nuts are also used for securing the core and coil in the case. The core and coil may be easily and quickly removed from the case by withdrawing these nuts and bolts. This feature makes the transformer very easy of repair.

As will be seen in Fig. 2, all leading-in or terminal wires pass through strong and heavy porcelain insulators, which are slipped in slots at the bottom of the case, and which are simply held in position by the cover. The eye-bolt is placed in most convenient position in the centre of the top of the case, and permits of the transformer being maintained in a perfectly vertical position when being raised, thus making it easy to hang. The two lower lugs are slotted, which permits of the placing of the lag screws before the transformer is raised, while on the same plane with these lugs is a lug in front of bottom of case, forming a leg, and upon which, together with the two lugs, the transformer can rest.

The transformer is thoroughly ventilated by means of the insulator slots in the bottom and a long protected slot in the top of the back of the case, which ensures cool operation of the coil. All the transformers are wound for a double-secondary voltage and T-connectors are provided

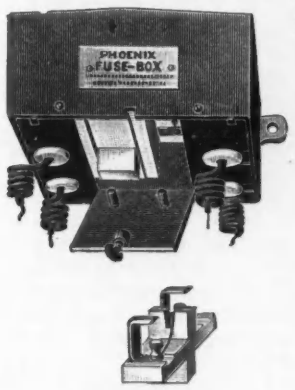


FIG. 1.

FIG. 2.

with which the connections may be readily changed without opening the case.

The separate fuse-box, illustrated in Fig. 1, contains the standard type of "Phœnix" cut-out, which is made of heavy vitrified porcelain and provided with ample contact pieces. The case is moisture and waterproof, and is convenient to install, besides being easy of access. The plugs, which are made of strong porcelain and fitted with durable contact blades and thumbscrews, are readily and safely reached through the hinged door. The two lugs cast on the door prevent the plugs from slipping out of position under vibration, and ensure a perfect and permanent contact. The construction of this useful device is such that the most dangerous and destructive arcs are instantly and readily broken without injury to the metal parts. This cut-out has proved to be the best and most effective cut-out made for high-potential circuits.

A Water-Circulating and Shaking Grate.

The grate we illustrate, made by the Water-Circulating Grate Company, 1026 and 1028 Filbert Street, Philadelphia, and known as the "Reagan" grate, secures from the principle of its construction a much larger air inlet in proportion to the grate area than is possible with the ordinary form of grate, thereby giving much better results, both in rate of combustion and in economy. As shown in the illustration, the grate consists of a series of two-inch extra-heavy pipes running the length of the grate and screwed with right and left hand threads into water boxes at either end of the furnace, these boxes performing the same office as an ordinary return bend; through these water passes from one pipe to the next, making the whole a continuous coil and also thus affording a most efficient feed-water heater.

Between the pipes are shakers or choppers, the surface of the choppers being in line with the centre of the pipe. If a board were laid across the plate it would rest on the water tubes, and the air passing through the grate would strike almost 100 per cent. of the lower surface of the board.

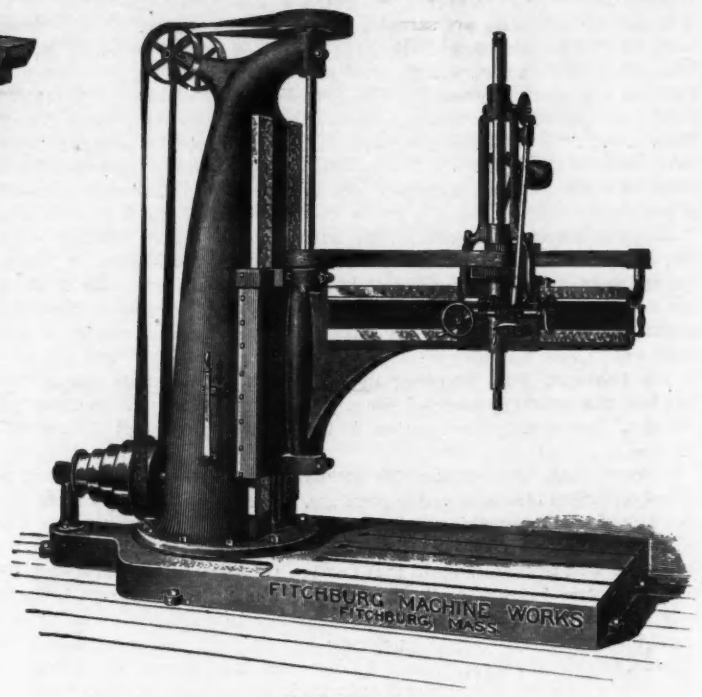
The air passes from tube to tube, the choppers cut out the ashes, and the result is that almost 100 per cent. of the bottom of the fire is exposed directly to incoming air. With the ashes removed as fast as they accumulate, the air passing through the choppers follows the curve of the pipe to the tube and is distributed to every portion of the lower surface of the fire. The air inlet obtained by this means is claimed to be fully 50

Water and Shaking Grate.

per cent. greater than that with the ordinary form of grate, while the entire lower surface of the coal is exposed directly to the air passing upward. This perfect distribution of air at the very bottom of the fire is one of the features which is claimed to account in part for the high efficiency attained. In a test made by Prof. H. W. Spangler, of the University of Pennsylvania, he found and reported that a boiler which he tested fitted with the Reagan grate "produced 27⅛ per cent. more horsepower than when fitted with a plain grate, and with a greater economy; thus," the report adds, "for a given quantity of steam required, assuming that four of the boilers in the plant tested are required to do the work, three boilers of the same size fitted with the Reagan grate using the same quality of coal would be all the boiler plant would require." The president of the Bridgeport Traction Company, in a letter to the manufacturer, states that his company saved 1288 tons of coal in six months through the use of these grates, amounting to a saving in money of $4057.20.

Radial Drill.

We illustrate herewith a new radial drill now being placed upon the market by the Fitchburg Machine Works, Fitchburg, Mass., and designed for a great variety of work, ranging from ordinary drilling to boring. The spindle is driven by means of a four-inch belt kept in tension by a tightener at the end of the arm, and applied with a semi-circular arc-contact to a pulley, which latter is back-geared as the cone of an engine-lathe, by means of which eight changes of speed are obtained. By this arrangement the smooth motion given by a belt is obtained with ordinary drilling, and for heavy drilling and boring the power obtained by the use of the back gears is applied direct to the spindle, all bevel gears being avoided. The feed or power is given by a cone of gears, with a friction attachment and six changes of feed, thus giving sufficient range for all varieties of work. There is also a hand-worm and worm-wheel feed, and quick return for the spindle, which latter is counterweighted. The drill head is moved along the arm by means of a rack and pinion, giving a quick movement, and can be firmly clamped in position when drilling. The arm is raised and lowered by power, and the saddle on the upright is of sufficient length to keep the arm square without clamping. The swinging arm moves easily on ball bearings, but can be clamped in position when boring. The diameter of the spindle is 2 3-8 inches and its traverse is 16 inches. The traverse of the head on the arm is 50 inches and its vertical movement 41 inches. The greatest height from the top of the bed-plate to the lower end of the spindle is 76 inches, and the greatest distance from the face of the upright to the centre of the drill is about 72 inches. The width of the bed-plate is 48 inches, and the weight of the drill, 11,900 pounds.



Radial Drill.

Electrical Novelties.

Various electrical novelties are being manufactured and introduced by the Birdsall Electric Manufacturing Company, 231 Broadway, New York, three of which are illustrated herewith.

Fig. 1 shows a jardiniere filled with artificial flowers, among which are two small incandescent lamps. Underneath the jardiniere is a music box, which in addition to playing music, opens and closes the electric current, thus lighting and extinguishing the lamps intermittently.

An electric cigar lighter is shown in Fig. 2, the battery for the ignition of the torch being located inside of the case.

A fancy clock with a small incandescent lamp for night illumination is represented in Fig. 3. Nearly every one who may happen to get up during the night "wonders" what time it is, and in order to find out a light of some sort must be struck. In this device, however, the mere pressing of the button on the front of the box will turn on light enough in front of the clock face to enable a person to ascertain the time.

The battery used in the operation of these devices is the Birdsall dry

Fig. 1.

Fig. 2.

Fig. 3.

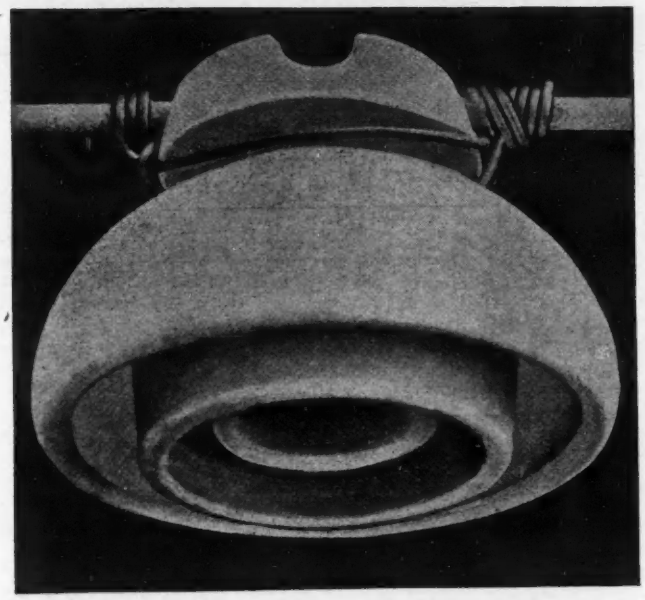
battery, which, it is claimed, will work satisfactorily for a period of from three to six months, according to the frequency of light.

The lamps used are of standard makes, although the Birdsall Company manufactures a lamp of its own, with a platinum filament, which, it is claimed, requires only two cells of battery for its incandescence.

Locke Insulators.

In the construction of electric lines nothing is so essentially important as the insulation, for any leakage means so much loss in dollars and cents. High insulation is, therefore, a prime necessity, and much time and thought have been applied by various inventors to the solution of the problem of securing the most perfect results.

Mr. Frederick M. Locke, of Victor, N. Y., has applied his efforts to producing first-class insulating material and devices. The accompanying illustration shows a china insulator which has given excellent results. Its support is a steel pin, so designed and constructed as to give great strength and durability. It is free from tendency to rot, and does not weaken the cross-arm as wooden pins do, on account of the comparatively smaller hole. These insulators can be applied to the under side of cross-arms, when it is desired to increase the number of lines without adding to the number of cross-arms.



HIGH-VOLTAGE INSULATOR.

The triple petticoat insulator is made of the highest grade of china ware. It is 5¼ inches in diameter and 4 inches high, and its insulation has been tested up to as high as 85,000 volts.

Electrical Measuring Instruments.

A complete line of new indicating instruments has lately been developed by Prof. Elihu Thomson, and is being introduced by the General Electric Company to meet the demand for low-priced, compact, permanent and accurate instruments for use on all alternating-current circuits,

FIG. 1.—THOMSON ALTERNATING-CURRENT VOLTMETER.

irrespective of frequency. They are known as the "Thomson Inclined Coil Portable Standard" instruments, and comprise an ammeter, a voltmeter and indicating wattmeter, and are being introduced as standards of the highest grade for all alternating-current measurements. The scales are exceptionally long and clear, and a depressible button operates a dead-beat attachment, which brings the needle immediately to rest without detracting from the sensitiveness of the instrument.

Accurate indications can be obtained on circuits of all frequency without regard to the wave form. In the construction of the instruments all parts liable to change are absent, consequently calibration and accuracy are ensured for an indefinite period.

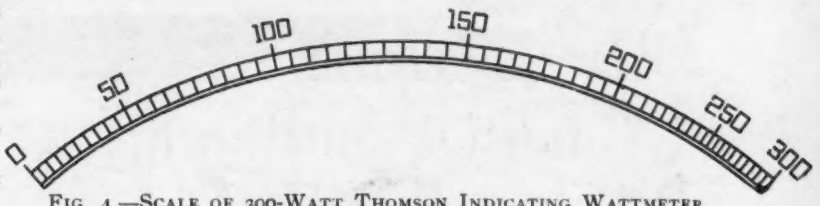


FIG. 4.—SCALE OF 300-WATT THOMSON INDICATING WATTMETER, (EXACT SIZE.)

While the ammeters are designed for alternating-current work, excellent results may be obtained when used on direct-current circuits, provided a high degree of accuracy is not required. The indicating wattmeter gives accurate readings with angles of lag on all inductive loads met with in commercial practice.

These wattmeters are especially valuable in testing and calibrating recording meters; testing transformers and measuring their efficiency; testing alternating-current arc lamps, incandescent lamps, fan motors,

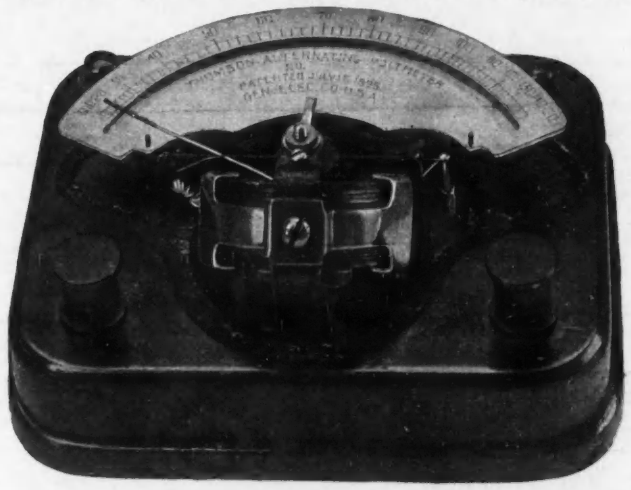


FIG. 2.—THOMSON ALTERNATING-CURRENT VOLTMETER, COVER REMOVED.

etc. The 100-watt indicating wattmeter has been especially designed for testing incandescent lamps. In using the wattmeter for direct-current measurement two readings are necessary, the connections being reversed between the two; the mean of the two readings giving the correct result.

These instruments are made in sizes to meet the ordinary requirements of commercial practice. The ammeters are made to read from 0 to 2, 10, 25, 50, 100 and 200 amperes, and the indicating wattmeter from 0 to 100,

FIG. 3.—THOMSON INDICATING WATTMETER.

300, 1500 and 2500 watts. They are accurate at any potential from zero to 150 volts, and the limit of current for each instrument is plainly marked upon it. The voltmeters are made to read from zero to 75 and 150 volts,

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, March 21, 1896.

GENERAL ELECTRIC stocks have been very heavy this week. The unloading by people who have bought low prior to the Westinghouse deal and wanted their profits had a dampening effect upon the price; the market was insufficient for the offerings. There has been considerable speculation of late as to the standing of the preferred stock of the General Electric Company in case there is a scaling of the capital in correction of the impairment. It has been maintained by some that this class of stock could not be called upon to make sacrifices. Bearing upon this the articles of incorporation contain the following clause: "The preferred is entitled in preference and priority over the common stock to dividends to be paid semi-annually out of the net profits of the company at the rate of 7 per cent. per annum. Such dividends are to be cumulative, and this stock is entitled to no other or further share of the profits and is without preference as to principal." There is 17½ per cent. accumulated interest due on the stock which is held to be a preference against principal.

ELECTRICAL STOCKS.	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	98	99
" " " Brooklyn	100	100	102½
" " " Boston	100	145	150
" " " Philadelphia	100	131	131¼
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	27½	28
Electric Storage, pref	100	29	29½
General Electric	100	36⅜	36¼
General Electric, pref	100	60	62
Westinghouse Consolidated, com	50	31	31½
" " pref	50	52	53
BONDS.			
Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	203	203½
American District Telegraph	100	33	40
American Telegraph & Cable	100	91	..
Central & South American Telegraph	100	120	124
Commercial Cables	100	157	..
Erie Telephone	100	59½	60
New England Telephone	100	88½	89
Postal Telegraph-Cable	100	84½	86
Western Union Telegraph	100	83½	83⅞
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	17⅜	17¾
Brooklyn Rapid Transit		21¼	22
Brooklyn Traction	100	10½	12
" " pref	100	45	48
Buffalo St. Ry	100	71	73
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	47	50
Hestonville	100	47⅛	48½
" pref		..	61
New Orleans Traction	100	17	19
" " pref	100	63	66
North Shore Traction	100	30	32
" " pref	100	80	82
Rochester St. Ry	..	28	33
Steinway, Ry	..	49	..
Union Railway (Huckleberry)		99	102
Union Traction, rcts $10 pd	..	15	15⅛
West End, Boston	100	69½	69⅝
" " pref	100	88	90
Worcester Traction	100	15½	17½
" " pref	100	87½	89½
BONDS.			
Brooklyn Rapid Transit 5s. 1945	100	79	81
Buffalo St. Ry. 1st con. 5s	100	105	107
Cleveland Elec. Ry. 1st mtge 5s	100	101	103
*Columbus St. Ry. 1st 5s	100	95	100
Rochester St. Ry. 1st 5s	100	98	101
Union Railway (Huckleberry) 1st mtge 5s		103½	105⅛
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

THE TRACTIONS.—The bulk of the trading this week in the traction list has been done in the Brooklyn Traction securities. The time in which the stock can be deposited under the plan of reorganization was extended from March 16 to to-day, and about 88 per cent. is said to have been deposited, leaving only about 10,000 out of a total of 90,000 shares. Both classes of stock are somewhat stronger than last week, due probably to the fact that the stockholders who did not intend to participate in the reorganization disposed of their holdings during last week and the early part of this. The common stock, as the majority of it has been deposited, is quoted with the 2½ per cent. assessment paid. The new Kings County Traction and the Brooklyn Traction preferred stock are exchangeable share for share, and consequently the quotations are identical. The stockholders' meetings of the various roads interested in the deal have been called for April 4. Two measures now under discussion at the State capital affect all the Brooklyn roads. One of them is to compel the roads to pay the city 3 per cent. of their gross receipts. The other provides that all railway companies in this State, with the exception of those in New York City, must have vestibules on their cars.

BUFFALO RAILWAY.—There has been practically no trading in Buffalo Railway stock pending the publication of something more definite regarding the terms of the agreement with the Traction Company. The latter company, it is said, will build part of its proposed line and operate it either in conjunction with or under the management of the Buffalo Railway Company, which is reported to have withdrawn its oposition to the new line.

OTHER SECURITIES are lifeless, with the possible exception of Worcester Traction, of which some little stock has changed hands.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, March 23, 1896.

J. H. BUNNELL & CO., 76 Cortlandt Street, are at work on a new catalogue which will include many new things in the way of electrical supplies.

THE GARVIN MACHINE COMPANY, Canal and Laight Streets, having lost all of its trade catalogues in the recent fire which completely destroyed its works, desires to secure new copies of the same.

THE E. S. GREELEY & CO., 5 and 7 Dey Street, are receiving many calls for Crookes tubes, Geissler tubes and induction coils for Rontgen ray experimental and research work. The company is in a position to fill orders for these goods with promptness.

MR. S. W. BLAKE, who represents in Northern New York the Eddy Electric Manufacturing Company, of Windsor, Conn., is visiting New York City for a few days. Mr. Blake represents well-established electrical machinery, and will be welcome among any of the electrical industry he may visit.

THE METROPOLITAN TELEPHONE & TELEGRAPH COMPANY has filed plans for a new 15-story building on Dey Street, immediately in the rear of the company's headquarters at 18 Cortlandt Street. The two buildings will be joined as one. The new one will be constructed of brick, and cost $400,000.

THE CARD ELECTRIC MOTOR & DYNAMO COMPANY, of Cincinnati, O., has established a branch office in the American Tract Society Building, 150 Nassau Street, with R. T. Lozier in charge, as general eastern agent. Mr. Lozier will bring to the attention of purchasers the full line of standard dynamos and motors made by the Card Company, and particularly its specialty of motors of unusually low speed for direct connection to the shafts of various forms of machinery and tools without the intervention of gearing or other speed-reducing devices.

ELECTRIC WIRES ON THE BROOKLYN BRIDGE.—Quite a revenue is derived by the Brooklyn Bridge trustees from the various telegraph and telephone companies for the privilege of stringing wires and cables under that great structure. The trustees charge $30 a year for each wire, and $250 a year for each cable so strung. Of the wires and cables carried over the river on the bridge, the Western Union Telegraph Company have 67 wires and one cable; the Metropolitan Telephone & Telegraph Company 612 wires; the Gold & Stock Telegraph 10 wires; the Postal Telegraph Company 6 cables, and the Commercial Cable Company one cable.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
927 Chestnut Street,
PHILADELPHIA, Pa., March 21, 1896.

L. M. MOYES, manufacturer of the combined safety water tube boiler, has moved his office from 411 Walnut Street to 1434 Randolph Street.

THE UNITED STATES METALLIC PACKING COMPANY has recently removed its office from 133 South Fourth Street to the factory, 427 North Thirteenth Street.

THE HELOIS ELECTRIC COMPANY, 1229 Callowhill Street, has just completed its new lamp for 7200 alternations. Wherever this lamp has been seen it has brought good orders.

THE UNITED TRACTION COMPANY, of Reading, has awarded the contract for 1000 tons of heavy rails to the North Branch Steel Company, of Danville, and for 20,000 yellow pine ties to Charles Este, of Philadelphia, Pa. The material will be used in relaying the company's Penn Street line.

THE TECHNIC ELECTRICAL WORKS, 129 Broad Street, has recently been re-organized with Mr. F. Lynwood Garrison as president, and will very soon enlarge their plant. They are making a specialty of high grade switches

of all kinds. A new catalogue is being prepared, which will soon be ready for distribution.

MR. CHARLES WIRT, 1028 Filbert Street, manufacturer of the Wirt dynamo brushes, has recently issued a very creditable little pamphlet, consisting of 22 pages, setting forth the good points of his brush. The pamphlet is known as Circular No. 26. He is also preparing for distribution a handsome catalogue which will soon be ready.

THE ELECTRIC PROTECTION COMPANY, manufacturers of plush protectors, Stevens flush switches and general electric work, 1026 and 1028 Filbert Street, reports that it is busy in all its branches, especially in flush switches and plush protectors. It has just placed large orders in San Francisco and Chicago, and has recently established an office at 126 Liberty Street, New York City, which is in charge of Mr. A. L. Fenton.

J. W. CREGAR, general agent of the Electric Maintenance Company, has recently moved his office from the Betz Building to 1220 Filbert Street. This company has charge of over 600 plants in Boston, New York, Baltimore, Washington and Philadelphia. It has two repair shops in Philadelphia, and employs 70 men, who are ready at all times for emergencies. Mr. Cregar is also open to accept the agency for any good company desiring to be represented in this section, with whom satisfactory arrangements can be made.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., March 20, 1896.

THE EDISON ELECTRIC ILLUMINATING COMPANY will erect another large station, building on Atlantic Avenue, near Congress Street. It will be about 50 feet in height, with a flat roof, and have a frontage of 150 feet.

THE RICE & SARGENT ENGINE COMPANY, Providence, R. I., is sending out to the trade a neat folder, giving considerable data regarding the two Rice & Sargent engines to be installed in the power-house of the West End Street Railway Company, Boston, Mass. The Rice & Sargent Company has just closed the contract for these engines, which will be of the cross-compound type.

ADJUSTABLE LAMP-HOLDERS.—A silver medal was awarded to the O. C. White Company, of Worcester, Mass., by the judges of the Centennial Fair at the Charitable Mechanics' Association, which was held in Boston the latter part of last year. The award was for adjustable holders for incandescent lamps made by this company. The report of the judges says: "In the exhibit is found a complete and thoroughly perfected system of joints and mechanical movements adapted to the most efficient use of the incandescent electric lamps. These fixtures are attached with equal facility to ceiling, wall or post, and they are adapted for use in any institution." The Goodyear Shoe Machine Company, of Boston, is using 300 of these adjustable holders in its factory, while others are being used in the Boston Public Library. A unique installation of these holders is in the shops of the Boston & Albany Railway, at West Springfield, where the devices are attached to the ceiling, which is 22½ feet high. The lamps can be moved about in a circle of 30 feet diameter.

WASHINGTON NOTES.

WASHINGTON, D. C., March 20, 1896.

SENATOR MCMILLAN has presented to the Senate resolutions recently adopted by the East Washington Citizens' Association favoring the municipal ownership of gas and electric light plants.

SENATOR HARRIS, of Tennessee, has introduced a bill in Congress amending the charter of the Washington & Great Falls Electric Railway Company. It practically grants a new charter to this corporation, the amendments being numerous and lengthy. The first addition is for a branch from the main line to the Georgetown & Tenellytown railway, with a view to giving the Methodist University grounds, about half way between these points, a service from either section of the District. The second addition is asked to give the company a loop at the terminus of the road, to prevent the shunting of cars on Prospect Avenue. Another amendment is intended to settle the question raised as to the legality of the company's bond issue. Another increases the capital stock to $650,000.

THE AUTHORITIES are beginning to open their official eyes at the violations of the law prohibiting the stringing of overhead wires. A day or two since a policeman reported that during the night two overhead wires had been strung over Fourteenth Street, just north of Rhode Island Avenue. This information set the Commissioners thinking, and they acted at once. True, no penalty was attached to violations of this character, and the law was practically inoperative. Nevertheless, they believed they could proceed against the law-breaker under the police regulations, and sent the superintendent of telegraph and telephone wires to ferret out the case. With a lineman he followed the illegal wire from pole to pole, until finally the responsible end was located in the office of the Western Union Telegraph Company. Orders from District headquarters were to take the wire down, and the lineman was prepared to cut it down, but the company promised to remove it and in a short time the wire was taken away.

SENATOR MCMILLAN, of Michigan, has been making the Anacostia railway problem a subject of study, and he has gone into diligent inquiries concerning the condition of the present company, the needs of the people in the suburb of Washington known as Anacostia, and the best way to procure rapid transit for them. He has received many petitions from the residents, and it has been claimed for some time that the day has arrived when the Anacostia traction facilities should be placed on a modern basis. Senator McMillan has therefore introduced a bill in the Senate which requires the present company to install an underground electric system along its lines within two years from the date of the passage of the act. The first section of the bill just introduced repeals the act of April 30, 1892, which gave the sanction and approval of Congress to the then existing route and terminus of the Anacostia & Potomac Railway Company. The second section provides that within five days after the passage of the act the Anacostia Company shall cease to run one-horse cars on its lines, and within two years shall dispense altogether with the use of horse-power on all of its lines, and shall substitute therefor an underground electric system of motive power.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., March 20, 1896.

FRANTZEN & BENNETT, electrical contractors, 353 Dearborn Street, have dissolved partnership, Mr. Bennett having retired from the firm. The business will be carried on under the name of Arthur Frantzen & Co.

MR. FRED. SARGENT, of the firm of Sargent & Lundy, has been engaged by the Milwaukee Street Railway & Light Company to remodel and improve the economy of its River Street power-house, which operates the railway system, and also the Badger central station, which furnishes the city lighting.

THE ROUNTREE MANUFACTURING COMPANY has been awarded the contract for the wiring of the new Chicago public library. The iron-armored conduit of the Interior Conduit & Insulation Company has been selected for conduits, and the wiring selected is that of the Safety Insulated Wire & Cable Company of New York City.

CANADIAN NOTES.

(From Our Own Correspondent.)

MONTREAL, Can., March 20, 1896.

HALIFAX, N. S.—The electric street railway is now in operation.

ST. JOHNS, N. F.—It is said that St. Johns, N. F., is to have an electric street railway.

HAMILTON, ONT.—G. F. Simpson is promoting an enterprise to supply electricity for lighting and power purposes.

NEWMARKET, ONT.—The installation of an electric light plant has been decided upon by the Town Council. Estimated cost, $8000.

BEAR RIVER, N. S.—It is reported that the Bear River (N. S.) Electric Company is to extend the Bear River light system to Digby, N. S.

THOROLD, ONT.—The Thorold, Ont., street railway is to be practically rebuilt this Spring. The trolley system will be put in and the line laid with T rails.

MONTREAL, QUE.—Surveys are being made for the new line of the Montreal Park & Island Railway, from the big bridge at Back River to St. Vincent de Paul.

AMHERSTBURG, ONT.—Application has been made to the government for a charter for the construction of an electric railway from Amherstburg to Harrow.

ST. CATHERINES, ONT.—The bill incorporating the Lincoln Electric Radial Railway Company has passed the Railway Committee of the Ontario Parliament.

QUEBEC, QUE.—H. J. Beemer is making arrangements with some capitalists from the United States for the immediate pushing of work on the new Quebec electric railway.

STRATFORD, ONT.—A project for the construction of a steam or electric railway from Embro to Stratford, a distance of 17 miles, is being considered by the Board of Trade.

WESTPORT, ONT.—W. H. Fredenburg will put in an electric light in Westport, Leeds County, Ont., provided the town will guarantee him 200 lights and two and one-half cents per light.

HAMILTON, ONT.—The Hamilton & Dundas Railway Company is desirous of changing from steam to electric traction, but fears to lose its Sunday trains by thus placing itself under the Ontario Act.

CAMPBELLFORD, ONT.—Some of the Campbellford, Ont., people are trying to organize a company to buy an electric road from Campbellford through Warkworth and Hastings to Norwood, and return by Havelock.

ST. THOMAS, ONT.—The City Council at St. Thomas, Ont., has decided to submit a by-law to the rate payers for the issue of debentures to build a street lighting and commercial electric light plant, at an estimated cost of $50,000.

TORONTO, ONT.—J. Barrett, of Toronto, Ont., is asking permission to erect poles and wires for the purpose of transmitting power and light throughout the township of York. The electricity will be generated at Humber.

VICTORIA, B. C.—The Victoria, B. C., Electric Railway is to be sold at auction on April 11, if not sold earlier by private sale by the bondholders. It is expected that they will buy in the road themselves and run it. The prospects for the unsecured creditors are not bright.

LACHINE, QUE.—The Town Council of Lachine, Que., will allow the Montreal Park & Island Railway running privileges in the town, with exemption from taxation for thirty years. It is contemplated to build this line at once, and to extend the Outremont line to St. Laurent during the summer.

OTTAWA, ONT.—The Ottawa & Aylmer Railway & Bridge Company, Limited, composed of the leading shareholders of the Ottawa Electric Street Railway Company, will begin the building of an electric railway to Britannia by the tenth of April, and anticipate having the line completed six weeks later.

HULL, QUE.—The Hull Electric Company has obtained water-power at Deschene Mills, for the operation of their electric railway and lighting plant. The estimated cost, aside from that of placing dynamos and other electrical machinery, is $25,000. The plant will be operated by five 60-inch special new American turbine water-wheels.

HAMILTON, ONT.—The H. G. & B. Electric Railway Company has an agreement with the H. & D. Railway Company by which it has permission to use the tracks of the latter on Main Street until June 30. It has asked to have this permission extended, but the H. & D. Railway Company has refused the

request, and the intervention of the Hamilton City Council is sought by the H. G. & B.

HAMILTON RADIAL RAILWAY COMPANY.—The Hamilton Radial Railway Company and Lake Shore Electric Railway Company have applied to the Nelson Township Council for right of way over a portion of the beach. The first-mentioned company proposes to build from Hamilton to Burlington this year. The Lake Shore Company has a charter to build a line from Hamilton to Oakville.—It is rumored that the Hamilton Radial Railway Company proposes to buy the old post-office building on James Street north, and convert it into a station.

MONTREAL, QUE.—At the annual meeting of the Citizens' Light & Power Company, Ltd., Montreal, the following officers were elected directors: R. Wilson Smith, president; ex-Alderman Lyall, W. McLea Walbank, vice-presidents: J. H. Burland, M. P. Davis (Ottawa), J. H. Hencault, mayor of St. Cunigonde, F. Dagenais, of St. Henri. This company is acting in concert with the Lachine Power & Light Company. It has also bought out the Standard Light & Power Company, whose rights extend all over the Province of Quebec. The company propose to put their wires underground at an early date.

English Notes.

(From Our Own Correspondent.)

London, March 11, 1896.

INTERIOR LIGHTING BY DIFFUSED REFLECTION.—A fine example of the new method of interior lighting by diffused reflection is to be seen in London at the present moment in the new buildings of the Union Bank of Australia. The fine main hall of the bank, which is 72 feet long, 53 feet broad and 20 feet high, is lighted by 91 groups of three 25-cp glow lamps, suspended in dish-shaped fittings, lined with dulled tin on the interior, the lights being suspended 6 feet from the ceiling. The resultant illumination is beautiful, uniform and amply sufficient, although at first sight an impression is left upon the mind, or rather upon the retinæ, of uniform gloom. This method of illumination is becoming very popular where large, lofty rooms are concerned and where the extra cost for current can be afforded.

THE RAWORTH HIGH-SPEED ENCLOSED STEAM ENGINE.—The Brush Electrical Engineering Company are now making under patents acquired by Mr. J. S. Raworth, a high-speed enclosed vertical steam engine for direct coupling to alternators and continuous-current dynamos. The chief points in the construction of this engine are the use of Corliss valves and automatic cut-off in the high-pressure cylinder, and of Wheelock valves in the low-pressure cylinder, these valves, however, being controlled without trip gear. The abandoning of the trip gear is owing to the very high speeds at which these engines are designed to run, and the amount of throttling which the valves give at very low loads is therefore considerable. It is claimed, however, that this throttling is an advantage, as it is according to a corollary of Willans law, which shows that at very high ratios of expansion, it is better to throttle the steam than to cut off in an early part of the stroke. It remains to be seen, however, whether the use of these forms of valves will, in a very high-speed engine, give economy superior to that which is obtained in well-known engines where simple throttle valves are used at all loads.

DIFFUSING AND DISTRIBUTING GLOBES.—There is, just at present, quite a boom in diffusing and distributing globes. Great efforts are being made to push the "Fredureau" globe, which is of transparent glass with prismoidal-shaped zones on the exterior. These globes are being sold at from 10s. to 20s. each, and present the usual cumbersome appearance of these highly scientific devices for increasing the useful flux of light from a luminous source, and for properly distributing the same. According to Prof. Silvanus Thompson, one of these globes, plus a metal reflector, will increase the light at 25 degrees from the vertical emitted from a 16-cp nominal glow-lamp from 10.25 actual candle-power to 16.25. More recently M. Andre Blondel's holophane globe has formed the basis for a limited liability company with £100,000 capital. This globe, as some of your readers are no doubt aware, is of transparent glass, grooved vertically inside and horizontally outside. It is somewhat prettier than its rival, and can be sold for 5s. The vendor, presumably not the inventor, is to receive in return for the sale of his patent rights, the sum of £80,000, payable as to £25,000 in cash, as to £25,000 in fully paid shares, and as to £30,000 in cash or fully paid shares at the option of the directors, leaving for the working capital of the concern the magnificent sum of £20,000. How on earth it is expected that any reasonable dividend can be paid on such a huge capital for so small a concern, especially when so small a portion of the capital is left in the concern, is for the eminent nonentities on the board to satisfy their minds and their consciences. Of course, a magnificent possible dividend of 33 per cent. or more is worked out by means of the usual prospectus-like mixture of plausible and sanguine assumption. It is stated that there are about 2,500,000 of gas-using customers in the United Kingdom. It is then assumed that each customer uses 10 burners. It is then further assumed that half of then are fitted with globes of some kind. It is then further assumed that the average life of each globe is five years. It is then further assumed that the Holophane Company will displace one-fourth of the globes at present in use, and will obtain a minimum net profit of 1s. per globe. A little arithmetic will now show that a 33 per cent. dividend is easily obtained, not to mention possible sources of profit from the sale of foreign patent rights. I have nothing personally to say against either of these ingenious devices, but it seems to me that their manufacture would be more suitable as an adjunct to the business of an ordinary globe-maker than as the sole basis for the business of a limited liability company, especially when we consider the precarious life of patents and the rooted disinclination the average householder has to departing from the beaten track.

HIGH-VOLTAGE LAMPS AND THEIR INFLUENCE ON CENTRAL-STATION PRACTICE.—The house wirer having been treated at the Institution of Electrical Engineers to a couple of papers, the turn of the central station manager has now arrived, and a paper with the above title was read last Thursday by Mr. G. L. Addenbrook. Mr. Addenbrook is not a central station manager himself, but he has evidently devoted some time and attention to problems of the question he deals with. After many searchings of heart, Mr. Addenbrooke states that he has finally decided that the adoption of the 4-watt per candle 220-volt lamp offers far greater advantages to the central station manager than the advent of a 2½-watt per candle 110-volt lamp, since in addition to the economical advantages of the latter as regards mains, the higher voltage offers several advantages in the way of the electrical working of tramways from the central station and of using motors. He admits that at the present moment 220-volt 8-cp lamps are more or less in the clouds, and that even 16-cp lamps of this voltage have a short life, a lower efficiency, and a higher cost than their 110-volt congeners, but he makes out that a 60 per cent. reduction in the cost of the kilowatt-hour—a reduction which, under the circumstances a central-station manager could well afford—will cover, so far as the consumer is concerned, the increased cost for current and renewals of the 220-volt lamp. A 60 per cent. reduction on the now ruling price of 6d. per unit, does not amount to more than ½d. Mr. Addenbrooke places the maximum area which can at present be worked from a single three-wire station as one having a three quarter of a mile radius. He then states that he finds that in the centres of large supplies the population per square mile is stated at about 30,000, whilst the average population per square mile is about 16,000. Assuming for London an average population of 25,000 per square mile, he has no difficulty in showing that it will require from 70 to 80 three-wire stations with the present 110 volts between outer to supply the whole of the metropolis. If, however, 220-volt lamps are used, the radius may be extended to two and one-half miles, and each station could supply an area of 25 square miles, so that six or seven stations would suffice for the electric supply of the entire metropolis, instead of 70 or 80. The paper concludes with a lengthy investigation as to the probable limits of the utilization of accumulators. Mr. Addenbrooke states that so short a time ago as 1891 he did not look for any fundamental alteration in central station practice as likely to arise from improvements in accumulators. Within the last two or three years, however, prices have gone down to such an extent, and the rates of discharge have gone up so much that he is decidedly more hopeful. He finds, after consultation with well-known makers, that an accumulator complete with buildings and fittings, can be laid down for £10 per kilowatt discharge for three hours, and that the upkeep need not be placed at a higher rate than 6 per cent. He further shows that from the point of view of cubic space occupied per candle hour, accumulators are in a better position than gasometers. Finally Mr. Addenbrooke works out that the cost of accumulators, notwithstanding recent reductions in price, works out at £40 per ton of lead-lined cell and lead plate. As lead only costs about £10 per ton, Mr. Addenbrooke is hopeful of a further reduction in the price of accumulators to 50 per cent. of the present list quotations. When that day arrives he sees no reason why accumulator storage should not be resorted to to a sufficient extent to take not merely the present share of the work, viz.: one third of the maximum load for three hours, but, like the gasometer, three fourths of the total. With 220-volt lamps, and accumulator storage adopted to this extent, Mr Addenbrooke looks forward to the day when there will be only one system of electrical distribution in existence, *viz.*: the continuous-current three-wire system with accumulators.

General News.

New Incorporations.

THE ROSLYN ELECTRIC LIGHT COMPANY, Roslyn, Wash., has been formed by Donald Thiery and L. E. Sallady, for the purpose of furnishing electric and gas light. Capital stock, $10,000.

THE HARDIN COUNTY TELEPHONE COMPANY was incorporated at Eldora, Ia., with a capital stock of $25,000. The incorporators are C. E. Albrook, J. D. Newcomer, C. E. Grief, W. S. Porter and C. F. Bennett.

THE ITHACA LIGHT & POWER COMPANY, Ithaca, Mich., has been incorporated for the purpose of manufacturing and furnishing electricity. Those interested are C. E. Webster, Wolf Netzong and James V. Crawford, Ithaca, Mich. Capital stock, $15,000.

THE GREENWOOD TELEPHONE & ELECTRIC LIGHT COMPANY, Greenwood, S. C., has been formed by Joel S. Boile, D. A. P. Jordan and J. A. Borksdale, for the purpose of erecting an electric light plant and putting in a telephone exchange. Capital stock, $2000.

THE CICERO HEAT, LIGHT & POWER COMPANY, Cicero, Ind., has been formed by Edwin M. Hinshaw, Orla D. Haskett, Cicero, Ind., and Leonidas L. Turner, Muncie, Ind., for the purpose of generating electricity and drilling wells for gas, oil and water. Capital stock, $50,000.

THE NATIONAL ANNUNCIATOR COMPANY, Angola, Ind., capital stock, $10,000, has been formed by William H. Waller, George W. Kirk, George R. Wickwire and William Wells, Angola, Ind., for the purpose of manufacturing an electrical invention known as the Train Annunciator.

THE OREGON & FOREST CITY ELECTRIC RAILWAY COMPANY, Oregon and Forest City, Mo., capital stock, $60,000, has been organized by J. E. Cummins, Oregon, Mo.; F. C. Oakley, Wyandotte, Kan., and R. C. Benton, Oregon, Mo., for the purpose of constructing a street railway.

THE OULEOUT ELECTRIC LIGHT & POWER COMPANY, Sidney, N. Y., capital stock, $25,000, has been incorporated by F. C. Wood, Franklin, N. Y.; H. S. Sewell, Wolton; W. F. Randall, Syracuse; and H. McDonegal, New York City, for the purpose of manufacturing and selling electricity.

THE HAGERSTOWN RAILWAY COMPANY, Hagerstown, Pa., is to operate a street railway in Hagerstown and to Williamsport, Funkstown and other points in the county. The capital is $220,000, and the incorporators are Christian W. Lynch, William Jennings, and J. A. Herman, of Harrisburg, Pa.

THE BIG TIMBER ELECTRIC LIGHT & POWER COMPANY, Big Timber, Mont., has been incorporated with a capital stock of $5000, for the purpose of furnishing electric light, heat and power. Those interested are John Martin, Sr., and J. S. Jeays, Livingston, Mont., and Charles Bowhay, Townsend, Mont.

THE BALLSTON TERMINAL RAILWAY COMPANY, Ballston Spa, N. Y., capital stock, $300,000, has been organized by A. N. Chandler, A. S.

Chandler, Philadelphia; C. H. Stanton, Brooklyn, and A. B. Paine, Ballston Spa, N. Y., for the purpose of building an electric street railway in Saratoga County.

THE GAS CONSUMERS' PROTECTIVE ASSOCIATION, Los Angeles, Cal., has been formed for the purpose of constructing gas and electric light plants. Those interested are William H. Smith, George C. Rockwell, Arthur C. Harper, Albert Lindley and William D. Newell, Los Angeles. Capital stock, $25,000.

THE NEW YORK ELECTRIC COMPANY, Youngstown, O., has been incorporated by Alfred H. Rice, William F. Bonnell, John C. Wick, Frank B. Medbury, and Thomas B. R. Fitch, for the purpose of manufacturing and dealing in electric lamps and other electrical apparatus and appliances. Capital stock, $12,000.

THE STERLING ELECTRIC SUPPLY COMPANY, San Francisco, Cal., has been incorporated by John R. Cole, A. H. Pennoyer, F. G. Cartwright, F. W. Gale, San Francisco, and F. N. Delanoy, Alameda, Cal., for the purpose of dealing in electrical apparatus and constructing electrical works Capital stock, $100,000.

THE COMMUTATOR COMPANY, Minneapolis, Minn., capital stock, $2000, has been formed by Everett F. Keister, Benjamin C. Bonreau, William G. Maske and Joseph O. Therien, Minneapolis, Minn., for the purpose of manufacturing commutator segments and electric railway supplies and specialties.

THE PUGET SOUND, MT. VERNON, TACOMA & EASTERN RAILWAY COMPANY, Tacoma, Wash., has been organized by C. L. Holmes, P. V. Caesat, L. R. Manning, I. W. Anderson, T. W. Enos and W. C. Wheeler for the purpose of doing a general railway, telephone, telegraph and electric light business. Capital stock, $2,000,000.

THE MOUNTAIN LAKE ELECTRIC RAILWAY COMPANY, Johnstown. N. Y., has been formed for the purpose of building and operating an electric railway from Gloversville to Carpenter's Lake. The promoters are Charles King, George Hendrie, Richard Ansell, Johnstown, N. Y., and J. C. Haggett, Bleecker, N. Y. Capital stock, $60,000.

THE WEST CREEK ELECTRIC & TOLL ROAD COMPANY, Denver, Col., has been formed for the purpose of building, operating and maintaining a toll and electric road between South Platte Station and the town of Pemberton. The promoters are B. B. Clawson, Arthur O. Williams and Sidney Williams, Denver, Col. Capital stock, $100,000.

THE DILLON, HANCHER & WHEAT ELECTRIC COMPANY, Wheeling, W. Va., has been formed for the purpose of making, using and dealing in electrical instruments, machines, appliances, apparatus, etc. Those interested are I. C. Dillon, A. A. Wheat, C. N. Hancher and E. T. Albert, Wheeling, W. Va. Capital stock, minimum, $500; maximum, $25,000.

THE SOUTH ORANGE ELECTRIC LIGHT & POWER COMPANY, South Orange, N. J., capital stock, $50,000, has been incorporated for the purpose of constructing, maintaining and operating works for the distribution of electricity. Those interested are Henry A. Page, South Orange; Edward D. Page, New York City, and William M. Haines, Englewood, N. J.

THE AMHERST & SUNDERLAND STREET RAILWAY COMPANY, Amherst, Sunderland, and Hadley, Mass., has been formed by Charles Deuel, Walter D. Cowles, William H. H. Morgan, Mendall W. Howard, Henry M. McCloud and Frederick L. Whitmore, for the purpose of constructing, equipping and operating electric railways. Capital stock, $50,000.

THE RAPID CITY GAS, ELECTRIC LIGHT & POWER COMPANY, Rapid City, S. D., has been organized by L. L. C. Brooks, St. Paul, Minn.; William Kennedy, Des Moines, Ia., and Edmund Smith, Rapid City, S. D., for the purpose of manufacturing and storing gas for public and private lighting, cooking and heating, and also manufacturing electricity for public and private use.

THE SECURITY ELECTRICAL INSPECTION COMPANY, San Francisco, Cal., has been incorporated by A. St. John Bowie, Oscar Blain, Joseph Napthaly, Alfred Bouvier and Samuel L. Napthaly, San Francisco, for the purpose of superintending the construction of electrical apparatus, furnishing appliances therefor and insuring against loss occasioned thereby. Capital stock, $100,000.

THE BURTON ELECTRIC COMPANY, New York, N. Y., has been incorporated in West Virginia, for the purpose of purchasing letters-patent for processes, apparatus, etc., for dyeing and cleansing by electricity, and for the sale and lease to others of the apparatus. Among those interested are John J. Moore, Springfield, Mass.; Walter A. Burne and James S. McCabe, Auburn, N. Y. Capital stock, minimum, $50,000, maximum, $1,000,000.

TELEGRAPH AND TELEPHONE.

ALEXANDER, IA.—Alexander is to be connected by telephone with the surrounding towns.

BURNET, TEX.—A telephone line will probably be constructed between Marble Falls and Llano.

CRISFIELD, MD.—The Town Commissioners have given a franchise to the Crisfield Telephone Exchange, which will at once erect lines.

SAN FRANCISCO, CAL.—The People's Mutual Telephone Company is seeking a franchise in this city for the establishment of a telephone system within the city limits.

MERCER, PA.—Capitalists of this place propose to unite every town in this county by telephone. A company has been formed with ex-Senator George W. Wright as president.

MOUNT STERLING, IA.—The talked-of telephone line between this place and Keosauqua is now a certainty. Work will be commenced as soon as the frost is out of the ground.

DETROIT, MICH.—The Detroit Telephone Company, which operates under the Harrison patents, has been granted a franchise by the City Council to establish a system in this city. It will give cheaper service than the old company.

BEAVER DAM, WIS.—The Wisconsin Telephone Company has been granted a franchise for an exchange in this place. Connection will be had with the company's general system.

MELLETTE, S. D.—A proposed telephone system will connect Mellette with Redfield on the south and Aberdeen on the north. It is expected that the lines will be ready for business by June 1, next.

FAIRMONT, MINN.—Fairmont has organized a telephone company with a capital of $25,000, and it is proposed to build a system here, which will be extended to the neighboring towns if advisable.

UNION CITY, MICH.—Rheubottom & Bond have been granted a 15-year franchise at Marcellus, Mich., for an electrical lighting and power plant; lights to be in operation within six months. The village retains the right to acquire the plant at the end of three or five years.

LIMA, O.—A company has been organized here for the purpose of bringing about inter-connection between the local telephone companies in Lima, Findlay and Bellefontaine. The plan is for each company to extend its lines to the county border, there to connect with the lines of the other companies.

SIOUX CITY, IA.—Mr. L. G. Wilson, of this city, is the inventor of a telephone system by which he claims that it is possible for 10 or 20 stations on one line to talk at the same time without cross interference, and the communication between any two subscribers cannot be overheard by any of the others.

PROVIDENCE, R. I.—The Providence Telephone Company has decided to increase its capital stock from $800,000 to $1,000,000, to meet the cost of recent and proposed improvements in its plant. The company has gone to great expense in placing its lines underground in this city and Pawtucket, and is now erecting a new building in the latter place.

KANSAS CITY, MO.—The Kansas City Telephone Company has perfected its organization by the election of the following named gentlemen as officers: Milton Welch, president; H. H. Noland, secretary; N. Oppenheimer, treasurer, and W. C. Weaver, manager. The company has already secured 2000 subscribers, and its annual rates for instruments will be $36 for business houses and $24 for residences.

BROOKLYN, N Y.—The New York & New Jersey Telephone Company has increased its capital stock from $3,500,000 to $5,000,000. New stock to the amount of $620,000 will be issued for the purpose of improving and enlarging the company's plant and system. A new building for the company's headquarters will be erected, and new exchanges in different parts of the city, and elsewhere within the company's territory, will be established.

ELECTRIC LIGHT AND POWER.

WORTHINGTON, IND.—It has been decided to establish a municipal electric light plant.

BALTIMORE, MD.—Baltimore proposes to issue a $1,000,000 loan for electrical subways.

HART, MICH.—The citizens have voted to issue $18,000 to construct a water and light plant.

OCALA, FLA.—The Light Committee has recommended the purchase of a $15,000 electric light plant.

WOODBURN, ORE.—The citizens will vote on the question of issuing $10,000 in bonds for a water and light plant.

LAMONI, IA.—Gardner & Johnston are seeking a 10-year franchise for an electric light, heat and power plant in this place.

MARQUETTE, MICH.—The City Council has decided to issue $10,000 in bonds to purchase additional electrical machinery.

CHARLES CITY, IA.—The citizens have voted in favor to grant an electric franchise to the Hildreth Electric Light Company.

WAUKON, IA.—Messrs. Speed & Thompson, of McGregor, have made a proposition to the people to establish an electric light plant.

HUNTINGTON, PA.—This city is without night light on its streets on account of some difficulty between the authorities and the electric light company.

WAVERLY, TENN.—The Council contemplates the establishment of an electric lighting plant. Address W. T. McCracken for further information.

ALDEN, IA.—The question of electric lights is being agitated. It rests with the City Council. A canvass of the town shows that 300 lights would be subscribed for.

AUDUBON, IA.—The town authorities are tired of running its own electric light plant without profit, and want to sell it. Kerosene is good enough for the Audubonites.

LEMARS, IA.—The electric light and motor-plant in this place is to be sold at sheriff's sale on April 15, to satisfy a bonded indebtedness. The plant is valued at $150,000.

GREAT NECK, L. I., N. Y.—A committee composed of prominent residents of this town will present a petition to the town officers for a lighting district to include the entire village.

PORTLAND, MICH.—At a recent election it was voted to bond the village for $15,000 for the construction of an electric light plant and a dam to obtain water-power for the operation of the plant.

ST. LOUIS, MO.—Richard P. McClure, 905 Pine Street, has received the contract to rebuild the Convention Hall, at St. Louis. Several thousand dollars will be spent for electric lighting equipment.

HOLYOKE, MASS.—The Connecticut River Manufacturing Company has purchased a 40-hp Ball engine for electric lighting from J. H. Houghton, Boston, representative of the Ball Engine Company, Erie, Pa.

WINONA, MINN.—The Winona Railway & Light Company has been formed here. Frank B. Kellogg and Frank A. Seymour, of St. Paul, and Edward Lees, of Winona, are stockholders. The purpose of the new company is to operate the Winona street railway and lighting plants now in a receiver's hands.

ANNAPOLIS, MD.—A bill has been introduced in the House for the incorporation of the Maryland Electric Power & Light Company, with a capital

stock of $1,000,000. The incorporators are Howard Munikhuysen, Edward P. Hill, Frederick Gilbert, Henry P. Scott and F. P. Colvin. The new company will probably utilize water-power.

TELLURIDE, COL.—It is reported that an extensive addition will be made to the electric plant of the Gold King mine. The San Miguel Consolidated Gold Mining Company has, it is stated, closed a contract with the Westinghouse Electric & Manufacturing Company, of Pittsburg, for the installation of the new plant, which will include two 800-hp two-phase generators, driven by two Pelton water-wheels. These generators will operate Tesla motors of various sizes scattered throughout the works.

NAPOLEON, O.—The Covington Electric Light, Telephone & Lumber Company has a 20-year franchise for electric lighting and a local telephone exchange. It has installed a 900-light Westinghouse alternator and expects a five-year city contract to be signed at next regular council meeting after three new councilmen are elected at spring election. The officers of the Covington Electric Light, Telephone & Lumber Company are W. H. Deeter, president and manager; W. A. Shelt, secretary and treasurer. The power plant is located at Greenville Falls, one and one half miles from town, having 26 feet head of water and a 20-inch Victor turbine wheel.

The Electric Railway.

COLUMBIA, S. C.—The Columbia Electric Street Railway Company has completed arrangements for a belt line in this city. Work will be commenced as soon as possible.

RYE, N. Y.—The Highway Commissioners of the town of Rye have granted a franchise to the Port Chester Electric Railway Company. The road is to be built from Port Chester to White Plains.

FARNUMSVILLE, MASS.—An effort will soon be made by a New York company to obtain a franchise for an electric road from Farnumsville, through Grafton *via* North Grafton to Worcester.

VERSAILLES, PA.—The Versailles Electric Railway Company has had preliminary surveys made for the extension of its road for five miles. The extension is to be begun as soon as possible.

MONTCLAIR, N. J.—At the meeting of the Town Council of Montclair the North Jersey Street Railway Company made application for a franchise for a trolley line on Bloomfield Avenue, from the Glen Ridge line to the Verona line.

ALBANY, N. Y.—The State Railroad Commission has granted an application of the Fulton Chain Railway for permission to build a road from Fulton Chain to the Old Forge House, at the beginning of the Fulton chain of lakes in the Adirondacks.

BALDWINSVILLE, N. Y.—At a recent meeting of the village board a franchise was granted to parties who contemplate constructing an electric road from Syracuse to this village. The franchise gives the parties right of way from the village limits through Syracuse to the south end of the river bridge.

PROVIDENCE, R. I.—The Union Railway Company of this city has decided to issue transfers. A $75,000 building is to be erected in the centre of the city, through which all the cars will pass, and at which point all transfers will be made. The object of this plan is to avoid the use of transfer tickets and prevent fraud. It is estimated that the maintenance of this system will cost the company $25,000 a year.

BOSTON, MASS.—During the hearing a few days ago before the Legislature Committee on Railroads on the subject of the proposed Union station in this city, Mayor Quincy made a few remarks regarding the future of suburban electric service. Referring to the Nantasket Beach line he said: "The success of that line has promoted the belief that the introduction of electricity in place of steam, at least for suburban service, is something that may be expected in the near future. Single cars, or possibly two or three cars, will be sent out at frequent intervals, so that the passenger will go to the railway station not to catch any particular train, but to wait only a few minutes for transportation."

SOUTH BEND, IND.—A conference has recently been held between representatives of a syndicate and others directly interested over the proposed scheme to build an extensive electric railway system in this section of the country. The plan seems to be to start from Lake County, and build roads to embrace South Bend, Valparaiso, Michigan City, Laporte, Elkhart and several other places, and eventually, as one interested party expressed it, to "relegate the railway systems of this country to almost mere carriers of freight, while improved electric lines will furnish the passenger service" The syndicate hat has this big project in contemplation is said to be the one that operates the interurban systems in New Jersey, and in which Daniel S. Lamont, W. C. Whitney, Tom W. Johnson, Mark A. Hanna and other well-known capitalists are interested. It is stated that active operations in this work will soon begin.

Trade and Industrial Notes.

THE AUTOMATIC SWITCH COMPANY, Baltimore, Md., has made a notable reduction in the price of its solenoid automatic motor-starter and starting-switch.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison Street, Chicago, is just distributing two catalogues, one of which is of Paiste specialties, and the other of P. & S. porcelain specialties. Both of these catalogues are supplied with special trade discount sheets giving the latest and lowest trade prices.

HAROLD P. BROWN, 68 Broad Street, New York, is much flattered by the recognition which his plastic rail-bond has received in foreign countries. During the winter, 8500 pairs of bonds were sold in New South Wales, Australia, after a most complete test of competing bonds in both this country and Europe.

THE UTICA ELECTRIC MANUFACTURING COMPANY, Utica, N. Y., is now manufacturing the Leary street railway turn-out switch. The company is very much gratified with the recent flattering orders for this switch. It is very busy in all its branches, and a large business this year is practically assured.

ELECTRIC LIGHTING SPECIALTIES.—The Dale Manufacturing Company, 22 Cortlandt Street, New York, has just issued its catalogue, No. 8, of electric and combination fixtures, shades, reflectors, etc. This company deals, as well, in shades, reflectors and materials for interior lighting. The catalogue is profusely decorated.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has issued a very attractive calendar for 1896-97 giving colored illustrations of the various classes of constructional work carried on by them. This company manufactures iron and steel bridges, buildings, roofs, etc., and is one of the most progressive in its line.

GEORGE W. LORD, of 316 Union Street, Philadelphia, manufacturer of Lord's boiler compounds, has recently issued an exceedingly tasteful advertising pamphlet which contains reproductions from some of the most celebrated paintings. The pamphlet is well worth the small trouble of applying for a copy, which is all that is necessary to obtain it.

MR. W. C. BALEDA, manager of the Utica Electric Manufacturing Company, Utica, N. Y., reports an increasing demand for its various electrical specialties, especially the arc knife and disc arc switches, lightning arresters and iron clad fuse boxes, also its mast arm, which is so constructed as to render the work of trimming the lamps much easier than by the old style of lowering the lamp.

THE FOWLER FOUNDRY COMPANY, of Chicago, has lately concluded a long series of experiments for the production of steel castings for electrical purposes, of a higher degree of permeability than has heretofore been offered to manufacturers. It now claims to produce a casting that meets the requirements of the manufacturers of electrical machinery better than has heretofore been done. It has extensive works and is increasing its business rapidly.

THE WATERTOWN ENGINE COMPANY, Watertown, N. Y., reports sales in February of 21 engines, aggregating 1385 horse-power. Many of these were sold for electrical purposes, including one of 100 horse-power to the New York Electrical Equipment Company, one of 100 horse-power to the Walcott, N. Y., Electric Light Company and one of 70 horse-power to Augustus Noll of New York. Among the sales are a fifth order and several second and third orders.

THE LAFAYETTE ENGINEERING & ELECTRIC WORKS, Lafayette, Ind, in the second edition of their catalogue of dynamos, arc-lamps, electrical specialties, steam machinery, power generators and motors, give some flattering testimonials regarding the merits of their manufactures. The main feature in the design of the Lafayette bipolar motors and dynamos is that there is but one field coil. The company also manufactures slow-speed, multipolar dynamos in various sizes and voltages.

EUGENE MUNSELL & CO., 218 Water Street, New York, importers and wholesale dealers in India and amber mica, are sending to the trade a large sample card, showing a variety of forms of mica for electrical insulation —stamped solid mica segments for all the standard railway motors, mica washers, etc. The company is in a position to furnish mica in both India and amber quality, in the sheet, or cut to any size or pattern; mica segments gauged to thickness for all the standard railway motors.

"HE IS WELL PAID THAT IS WELL SATISFIED."—This truth is printed over the cover of a pamphlet just issued by the Cincinnati Milling Machine Company, of Cincinnati, O., which contains a long list of testimonials from users of their machines. This company has for years manufactured milling machines and a universal cutter and tool grinder, of which lines it makes a specialty. Judging from the tone of the testimonials, the machines made by them give undoubted satisfaction.

YOUNGLOVE & GERE, manufacturers of woven wire dynamo brushes, Syracuse, N. Y., commenced the manufacture of these brushes in 1892, from which time the demand for their brush has steadily increased and is now adopted by some of the largest electric light and power stations in the country. That these brushes are unquestionably popular is evidenced by the many testimonials received by the manufacturers. It is claimed that some of these brushes have been in constant use day and night for three years.

THE COOK-STODDARD MANUFACTURING COMPANY, of Dayton, O., has recently added to its factory a department for the manufacture of generators, motors and other electrical machinery. Mr. J. C. Shawhan, formerly of the Shawhan-Thresher Electric Company, will have charge of the electrical department. Mr. Shawhan has had a long practical experience in designing and building electrical machines, and the Cook-Stoddard Manufacturing Company has built up so excellent a reputation in the manufacture of gas engines that the trade anticipate excellent results from this combination.

THE MICA INSULATOR COMPANY, 218 Water Street, New York, is sending to the trade a large sample card, handsomely gotten up, showing samples of "micanite" commutator segments, rings, and slot insulation, for the various standard railway motors and power generators. "Micanite" and "Empire" insulating cloth and paper are shown in nine different grades, which are used largely for insulating armature cores and fields. The card has been gotten up at considerable expense, and has been sent to all manufacturers of electrical machinery, electric repair companies, and street railways in the United States, and is highly appreciated.

THE PHŒNIX TRANSFORMER.—Since placing the Phœnix transformer upon the market less than a year ago, the Louisville Electrical Works, of which Mr. Campbell Scott is the proprietor, has sold a very large number of them, and they state they have yet to receive the first complaint against them, while, on the contrary, judging from the many complimentary testimonial letters received, they are all giving the most absolute satisfaction. The Phœnix transformer, being claimed to possess many features of extreme merit in its mechanical construction, has proved that no transformer made gives better results electrically than it does. Its efficiency under all loads, its regulation, and its leakage or iron loss are unsurpassed. Judging from the great success with which this transformer has met during the past year, we can see no reason why the Louisville Electrical Works should not be a very busy concern during the next year.

THE KEELER & COOKE CO., of 166 Elm Street, New York, has been reorganized and the firm name changed to the Keeler & Hansell Co. Mr. William H. Hansell, who was formerly connected with the Charles Scott Spring Company, of Philadelphia, as manager of its street railway department, has become president of the Keeler & Hansell Co.; Mr. Louis M. Keeler, is secretary and treasurer, and Mr. Chas. Cooke, superintendent. Mr. Hansell's office is in the Philadelphia Bourse Building. The factory will remain at its old address, but the plant has been greatly enlarged and new machinery put in. In addition to the manufacture of machinery and railway springs it will now manufacture agricultural, bicycle and windmill springs, and will keep a large stock of steel on hand, which will enable prompt delivery to the trade. Mr. Cooke, the superintendent, has been all his life in the spring business, having spent 12 years with one of the largest spring manufacturing companies in this country.

M. T. DAVIDSON, manufacturer of the "Davidson" steam pump, reports business very good, with every indication that it will continue so. The works in Brooklyn, N. Y., are running full time, with a full complement of hands, filling a number of notable orders, principally for marine service. For the United States Navy Department there are now under way two Davidson vertical twin air pumps having air cylinders 25 inches in diameter. These are for the United States steamer *Chicago*. Mr. Davidson is also putting in the entire equipment of pumping machinery for United States Gunboat No. 10, now building at the Crescent Shipyard, Elizabethport, N. J., and is equipping Mr. E. S. Renwick's new steam yacht *Giralda*, as well as one building at the yards of Messrs. W. & A. Fletcher, from plans by J. B. Webb. Other orders for marine pumps now in hand at the Davidson shops are pumps for a steam yacht being built at Newburg, N. Y., for Messrs. Gardner & Cox, and for a new tugboat being constructed by Messrs. W. J. Davidson & Co., of Port Richmond, S. I.

TEN THOUSAND HORSE-POWER OF VICTOR TURBINES.—The Stilwell-Bierce & Smith-Vaile Co., Dayton, O., has taken the contract for the complete water-power plant to be installed at the Lachine Rapids in the St. Lawrence River. This power, which is second only to Niagara Falls in importance, is being developed by the Lachine Rapids Hydraulic & Land Co., Limited, of Montreal, Canada, and is located at the famous Lachine Rapids on the St. Lawrence River so well known to tourists, about five miles above Montreal. The initial development will amount to 10,000 horse-power. The work of construction has already begun, and the company expects to be prepared to furnish power before the close of this year. The above contract is for 66 large size "Victor" turbines of the latest pattern and all connecting machinery needed for transmitting the power of these turbines to the electric generators. This is probably the largest order for turbines ever placed at one time, and will certainly add to the enviable reputation already enjoyed by the Victor turbines.

THE MANUFACTURERS' ADVERTISING BUREAU, Benj. R. Western, proprietor, which has been located for a number of years at 111 Liberty Street, New York City, will remove about April 15 to more commodious quarters at 126 Liberty Street. This firm is widely and favorably known throughout both this country and abroad and is unique in the business it transacts, which is unlike any other in the world, and consists in taking entire charge of the newspaper work and advertising for manufacturers who desire this very important department of their business conducted with the greatest convenience and profit. The bureau handles almost exclusively concerns who advertise in the trade journals, Mr. Western being a recognized expert in advertising media of this character, and has established a reputation for commercial integrity and scrupulous attention to the interests of its clients of which it may well feel proud. A large number of the leading machinery concerns in the country now entrust their advertising to the care of this institution. It is because of a growing need for better facilities to transact its business that the change from 111 to 126 will be made. The Manufacturers' Advertising Bureau is credited with being the largest user of advertising space in the trade journals in the United States.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 17, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

556,342. ELECTRIC-MOTOR RHEOSTAT; T. J. Fay, New York, N. Y. App. filed Dec. 12, 1895. The combination of a rotary shaft, a rheostat frame mounted thereon, a rheostat in said frame, a series of contacting rings, suitably insulated from each other and mounted upon the same shaft and forming the terminals respectively of the various sections of the rheostat, a brush constantly in contact with one of said rings, an adjustable brush adapted to make contact with any of said rings, and means for moving said adjustable brush. (See Illustration.)

556,359. SYSTEM OF MULTIPHASE DISTRIBUTION; R. D. Mershon, Pittsburg, Penn. App. filed April 11, 1895. The combination with a three-wire three-phase alternating-current system of distribution, of three transformers having their primaries connected with the respective main-line conductors, six secondary terminals derived from the secondary coils of the said transformers, a rotary transformer having a single closed armature winding, and conductors leading from the respective secondary terminals to corresponding points of the armature-winding of the rotary transformer.

556,362. ELECTRICAL CONNECTOR FOR ARC LAMPS; J. J. McGill, Thorold, Canada. App. filed Jan. 15, 1896. The combination with an insulator of a ball-and-socket metal connection between the end of the loop-line wire leading from the lamp, and the wire carried by the insulator leading from the line.

556,386. ELECTRICAL GAS-COCK; H. L. Tyler, Corning, N. Y. App. filed June 20, 1895. In an electrically-controlled gas-cock, a casing having an inlet gas passage, a valve arranged to cover and uncover said passage, and opposite exteriorly-arranged electromagnets, the cores of which are detachably fitted in opposite sides of the casing in line with the valve. (See Illustration.)

556,408. RHEOSTAT; T. J. Fay, Brooklyn, N. Y. App. filed Dec. 19, 1895. In a rheostat or switch the combination of a controlling lever, an electromagnet, the lever being pivoted to one of the poles of the magnet, a spring arranged to swing the lever on its pivot, the magnet being included in two circuits adapted to oppositely magnetize its core.

556,414. ELECTRIC HUB WELDING MACHINE; C. E. Harthan, Lynn, Mass. App. filed June 20, 1891. In an electric metal-working apparatus, the combination of two electrodes adapted to squeeze or compress the work between them, a source of electrical energy with one terminal of which one of said electrodes is connected and means for connecting the other electrode temporarily and directly with the other terminal of said source when it moves forward to compress the work and for disconnecting it when moved backward to free the work.

556,425. ELECTRICAL REGISTERING INSTRUMENT; H. Lemp, Lynn, Mass. App. filed March 12, 1891. In an electrical counter or register for alternating-current circuits, an actuating electromagnet having an iron core and coil arranged so that the iron of the core will saturate with a very small fraction of the maximum current employed in operating the register.

556,426. ELECTRIC METAL WORKING APPARATUS; H. Lemp and W. B. Lewis, Lynn, Mass. App. filed April 23, 1891. In an electrical metal working apparatus, the combination with a central or immediate work-holder or electrode of two or more electrodes, or work-holders arranged around the same, and independent cut-off mechanisms controlled by each movable clamp or work-holder whereby the flow of current to each may be cut off or stopped at a predetermined point in the movement thereof, independently of the movement of the others.

556,428. ELECTRIC PROGRAMME CLOCK; J. P. Luxmore, Chicago, Ill. App. filed Nov. 14, 1894. The combination in an electrical reminder of a clock with a time-indicating dial and a clock mechanism, a contact arm revolved thereby, a series of contact points in the path of said contact arm, a series of contact strips each provided with a series of holes corresponding to the hours and fractions thereof of a day, conductors leading from the contact points close to such holes, means for connecting the strip and conductor at such holes, a revoluble disc having a surface of non-conducting material, a conducting-section on such surface, a series of contacts arranged circumferentially around such disc and connected to such contact strips, the conducting section of said disc so situated that it is successively brought into contact with the contacts arranged therearound as the disc is revolved.

556,437 ELECTRIC ARC LAMP; G. C. Pyle, Indianapolis, Ind. App. filed May 2, 1895. In an arc lamp a suitable holding-bar mounted parallel with the upper electrode, a spring-controlled clamp for grasping the upper end of the electrode and slidably mounted on the holding-bar, and an arm extending from the holding-bar and having on its end a ring with a series of inwardly and downwardly extended fingers or claws to hold and support the electrode at its lower tapering end.

556,479. ELECTRIC ARC LAMP; T. Spencer, Philadelphia, Pa. App. filed July 1, 1895. In an arc lamp having a frictional feed-regulator, a magnet controlling the same and regulating the length of the arc and an independent stopping device for limiting the extent of slip of the friction mechanism.

556,488. MOTOR SUSPENSION; N. C. Bassett, Lynn, Mass. App. filed Nov. 27, 1895. A suspension for car motors comprising a truck frame, a wheeled axle mounted in the frame, a motor geared to the axle, and a support for the other end of the motor, consisting of a bar or yoke so bent as to be supported upon the truck frame at substantially the plane of the centre of gravity of the motor.

556,496. TELEPHONE; C. F. Dunderdale, Chicago, Ill. App. filed May 24, 1895. In a telephone, a diaphragm constituting one electrode, a back piece in proximity to the diaphragm, a conducting body or conducting bodies disposed between the electrodes aforesaid, and a mass or quantity of comminuted or granulated conducting material surrounding the conducting bodies aforesaid.

556,502. ELECTRIC DRILL; M. Hebgen, Butte, Mont. App. filed July 16, 1895. In an electrically-operated rock-drill, the combination with a hollow armature and shaft, of a water-tight casing which constitutes the field magnet of the motor, a hollow drill-operating shaft to rotate with and move longitudinally in the hollow armature shaft, positive mechanism for feeding the hollow drill-operating shaft, and a manually operated lever for interrupting and controlling the feed movement.

556,510. ELECTRIC SWITCH; N. Marshall, Boston, Mass. App. filed Dec. 14, 1895. In a quick-acting switch, the combination with the following instrumentalities, viz: A pivoted contact member provided with a lug or projection, a pivoted actuating bar or plate, provided with a lug or projection normally in line with the lug or projection on the contact member, a spring encircling the pivot for the said contact member and actuating bar or plate, and provided with arms engaging the opposite sides of the said lugs to normally hold the said lugs in line with each other, each of the said arms being placed under tension by the movement of the lug on the

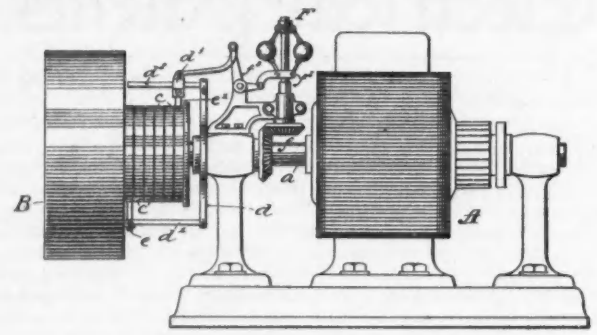
actuating bar away from or out of line with the lug on the contact member and means to lock the said contact member in its open or closed positions.

556,516. ELECTRIC RAILWAY SYSTEM; B. E. Osborn, Auburn, N. Y. App. filed Sept. 3, 1895. In an electric railway system the combination of a casing or conduit provided with pockets or chambers extending inwardly from one of its longitudinal faces and formed of less height and length than the thickness and width of the casing or conduit, a line conductor arranged in the casing or conduit and passed through the pockets or chambers and supports movable in the pockets or chambers toward and away from the line conductor and provided with means for engaging said conductor.

556,524. ELECTRIC HEATER; J. E. Williamson, C. E. Collins and J. B. Graham, Allegheny, Pa. App. filed Feb. 9, 1894. An electric heater for oil wells consisting of a perforated shell, screw caps, a positive insulated conductor terminal, a negative insulated terminal and a tube with a bell mouth.

556,544. BATTERY CONNECTION; M. M. Kohn, Chicago, Ill. App. filed July 29, 1895. The combination with a metallic cup, of a battery cell provided with a metallic casing connected with one pole of the battery, the end of said casing being adapted to fit into said cup to complete electrical connection therewith, and to be supported in position thereby, a terminal provided upon the opposite end of said battery insulated from said casing and connected with the opposite pole of the battery, and contact springs adapted to grasp said terminal, said contact springs and said metallic cup forming the terminals of an electric circuit, whereby the battery may be placed in position by a simple movement and without the intervention of binding parts, necessitating screwing or other manipulation.

556,553. RAILWAY CROSSING SIGNAL; R. O'Toole, Thurmont, Md. App. filed Feb. 20, 1895. In a railway crossing signal, the combination of a track and a pair of track-bars located beside said track, one in front of the other, with a pair of electromagnets and a pair of circuit-closers, said circuit-closers being so constructed as to open, except when closed by a weight, mechanism connecting the armatures of the magnets with the weights of the circuit-closers for lifting the said weights when the magnets are energized, and means for automatically suspending said weights during a specified period after having been raised.



No. 556,342.—Electric-Motor Rheostat.

556,577. PNEUMATIC SIGNALING APPARATUS; S. P. Hull and J. H Boylett, Poughkeepsie, N. Y. App. filed Jan. 9, 1895. In a pneumatic signaling apparatus the combination of a signal post formed in sections, one of said sections forming an air-storing chamber, a semaphore pivotally secured upon the post, a weighted arm to hold said semaphore in a normally raised position, a cylinder, a piston operating in said cylinder and having its upper end pivoted to the semaphore arm and normally depressed, connections between the storing chamber and the base of the cylinder normally closed, whereby air may be admitted to the cylinder to raise the piston and lower the semaphore, a magnet mounted adjacent to said connections and adapted to open the same when energized, connections between said magnet and a switch, a pump arranged adjacent to the signal post and connected with the air-chamber, and a wheel adapted to be operated by the passage of trains to actuate the pump.

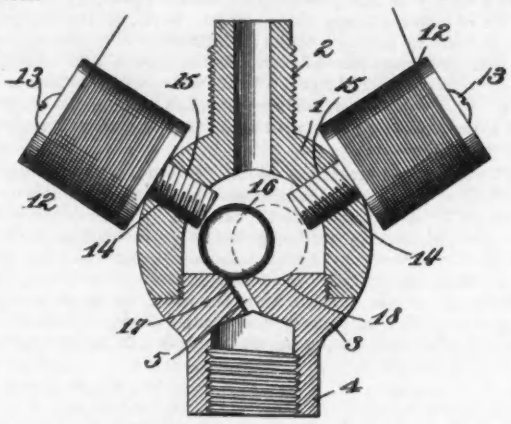
556,602. UNDERGROUND CONDUCTOR FOR ELECTRIC RAILWAYS; G. Westinghouse, Jr., Pittsburg, Pa. App. filed Jan. 6, 1894. A conductor for electric railways composed of two like halves fastened together by means of conducting devices and having adjacent contact-faces separated by a clear space. (See Illustration.)

556,609. TELEPHONE SWITCHBOARD; I. Anderson, Saginaw, Mich. App. filed July 8, 1895. In a telephone switchboard, an electromagnet, the core of which is included in the circuit of the telephone, the working battery in circuit with the magnet to energize the same, a circuit-roller having a contact core in circuit with the working battery, a movable armature for the magnet having a pawl connection with the roller to partially rotate the same, a suitably supported circuit-closing lever normally resting against the core of the circuit-roller and a main-line branch wire having a circuit connection with the armature and also with said circuit-closing lever.

556,617. ELECTRO-THERAPEUTIC APPARATUS; W. Carter, Louisville, Ky. App. filed Jan. 29, 1896. An electro-therapeutic apparatus comprising a motor generator, a circuit for a direct and a circuit for an alternating current, a regulator in each circuit consisting of a series of resistances, a switch arm to cut the same in and out, and a lesser series of resistances differentiated from but connected with the first, a switch arm to cut the same in and out of circuit and a patient's circuit in shunt to the regulator.

56,646. DEVICE FOR DETECTING SHORT CIRCUITS; C. F. Scott, Pittsburg, and C. E Skinner, Allegheny, Pa. App. filed Dec. 31, 1892. The method of detecting whether or not a closed circuit is present in a given coil which consists in varying the number of lines of force passing through said coil and determining whether or not said coil is heated thereby.

556,654. ELECTRIC LOCOMOTIVE; T. E Adams, Cleveland, O. App. filed Sept. 5, 1894. The combination with a truck-frame and an axle, of a motor geared with the axle at both ends, and device so suspending the motor from the truck-frame that the weight of the motor and the parts carried thereby will be equally distributed at opposite sides of the suspending devices.



No. 556,386.—Electrical Gas-Cock.

556,660. SECONDARY VOLTAIC BATTERY; W. A. B. Buckland, London, England. App. filed July 15, 1895. A perforated plate for a secondary voltaic battery, having slots and provided with a surrounding frame, a plurality of T-shaped sections arranged at opposite sides of the plate, and having their projecting parts engaging the said slots to form a plurality of compartments at each side of the plate, which are charged with active material, the material in the compartments at one side of the plate communicating with the material in the compartments at the opposite side of the plate through the perforations in said plate, and said active material being held in place by the surrounding frame and by the said T-shaped sections.

556,670. BLOCK SIGNAL TELEGRAPH; C. M. Grace, Philadelphia, Pa. App. filed Sept. 10, 1895. In a telegraph system consisting of a suitably-charged feed-wire, a line-wire, a number of stations connected in multiple through suitable resistance to said feed-wire, each station provided with a loop of the line-wire, two sounders, one on each side of the loop, two 2-pointed keys normally completing the loop through a bridge wire, a switch having its arm connected with the bridge-wire and its contact point grounded, and a conductor connecting the normally-open contact-points of the keys to the feed-wire.

556,693. ELECTRIC LAMP; C. E. Quimby, New York, N. Y. App. filed Aug. 18, 1893. As an improved article of manufacture, an incandescent electric lamp formed of an annular glass globe, an annular illuminating conductor, a metallic shield enclosing one half of the lamp and extending through the central aperture of the lamp beyond the plane of the annular illuminating conductor and a heat-insulating backing applied to the metallic shield.

556,708. PORTABLE FARADIC BATTERY; J. E. Unger, New York, N. Y. App. filed Feb. 6, 1896. The combination with a tubular central portion of non-conducting material, an induction-coil applied to the same, a casing fixed to the said central portion, a battery located in the same and electrically connected with said fixed casing, electrical connection between the carbon element of the battery and the induction-coil, a vibrator and a switch for starting and interrupting the induction-coil.

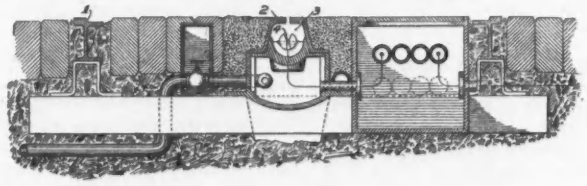
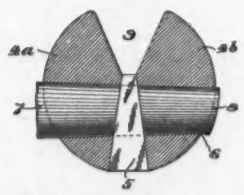


Fig. 2



No. 556,602.—Underground Conductor for Electric Railways.

556,718. ELECTRICAL APPARATUS FOR DRILLING WELLS, TUNNELS, ETC.; P. Semmer, Irwood, Pa. App. filed Aug. 16, 1895. In an apparatus for drilling wells, etc., a device for temporarily securing a section of the apparatus to the side of the well, said device consisting of a perpendicularly-journaled arm, a receptacle located at the outer end of the side arm, a substantially globular air-cushion located in said receptacle, a tube connected with said cushion and adapted to convey air to the same, said cushion when inflated adapted to come in contact with the side of the well and retain the section.